ELECTRICAL CONSTRUCTION AND MAINTENANCE

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October • 1948

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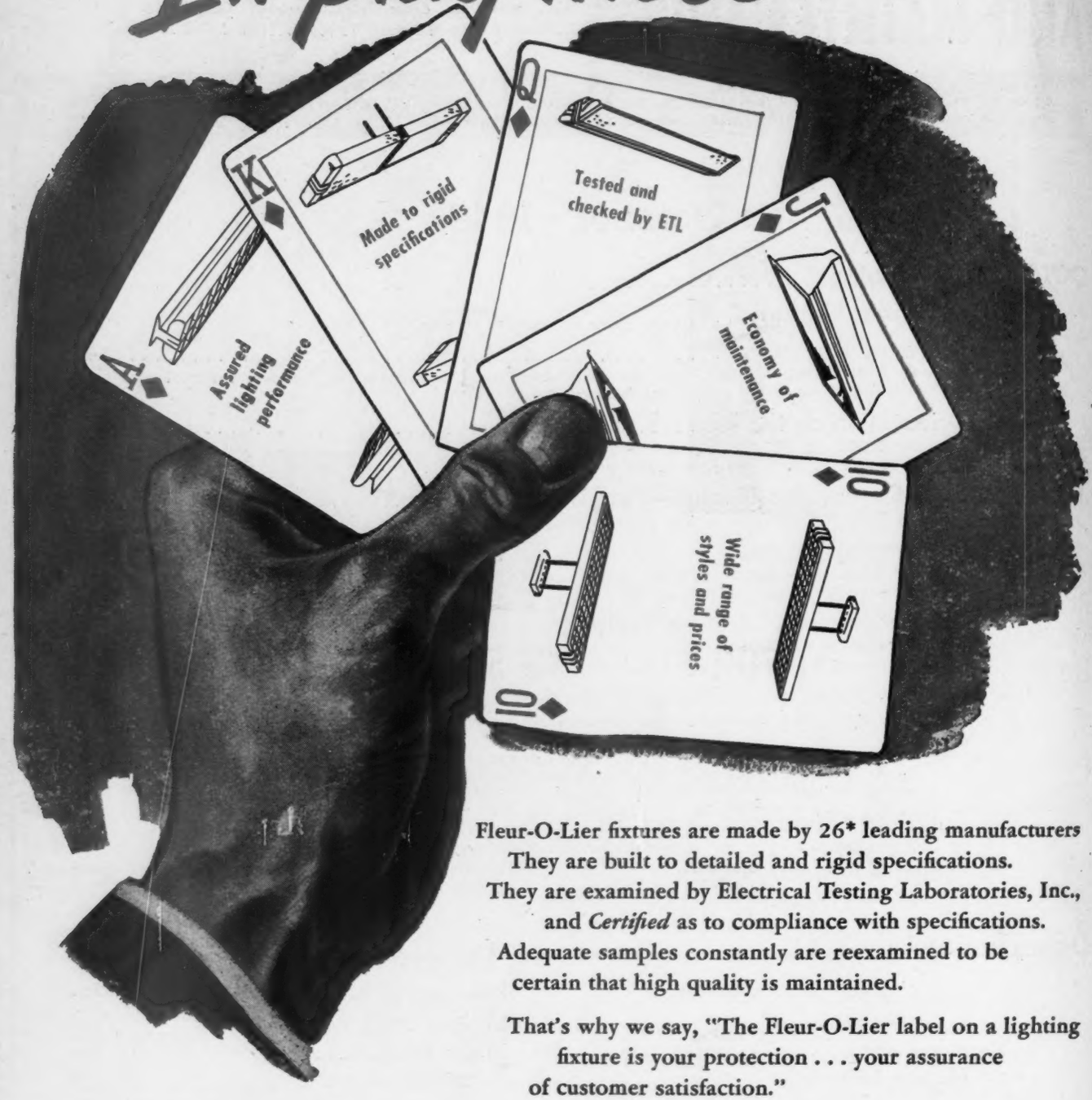
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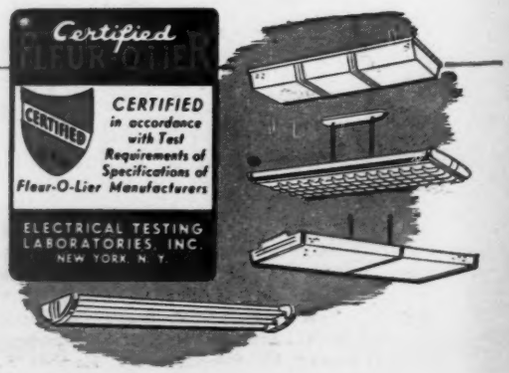

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OCTOBER . . . . at a Glance

More Electrical Risks

Continued increase of electrical use on existing wiring systems is creating new hazards at a rate that is difficult to appraise. So long as overcurrent devices are in place and properly rated, damage is unlikely, but persistent operation of fuses or breakers is always a challenge to the harassed but handy homeowner to "fix" them. Many inspectors have a "rogue's gallery" of the methods used with the resulting loss.

A little plain salesmanship by neighborhood electrical contractors could nip such hazards with ease and in all probability at a tidy profit. An inexpensive mail campaign or old fashioned door bell pushing at this time could be an important public service. Figuring that folks will know when they have electrical hazards and will naturally call an electrical contractor is an unhappy but chronic delusion in this industry.

Salesroom Lighting

While new automobile sales in these times would be booming if conducted in a telephone booth under candle light, there'll come a day. And business will head toward the well situated and well lighted automobile salesroom. Large areas, polished surfaces and shining chrome pose some difficult problems for the lighting specialist. Modern lighting techniques are capable of producing compelling sales emphasis. B. C. Cooper analyzes auto salesroom methods in his lighting techniques series on page 66.

Practical Orientation

H. N. Crowder, of Allentown, Pa., sponsors a training program for high school electrical students which is one of the finest public relations jobs we have seen. Students are routed through the shop, learn the rudiments of shop work, make calls with salesmen, study office methods, learn about business in business surroundings. Practical orientation stimulates interests, earns civic recognition, spots promising young men. Read "Orientation on the Job", page 58.

Aluminum Plant

Use of aluminum in wiring systems has been stimulated by shortages of such traditional materials as copper and steel. As these shortages ease, the use of aluminum will take its place in electrical construction work on a normal basis of engineering qualities and cost determined by the practical experience of electrical contractors.

The new Alcoa plant at Davenport, Iowa, would be an outstanding example of electrical construction methods and techniques if the materials employed were conventional. Its use of the first all-aluminum distribution system makes it one of the most important projects of the postwar era for electrical construction men.

An objective, inside story of this huge project by J. Raymond Meehan, Vice President of Fischbach and Moore, Inc., electrical contractors, "Alcoa of Davenport" begins on page 49 in this issue.

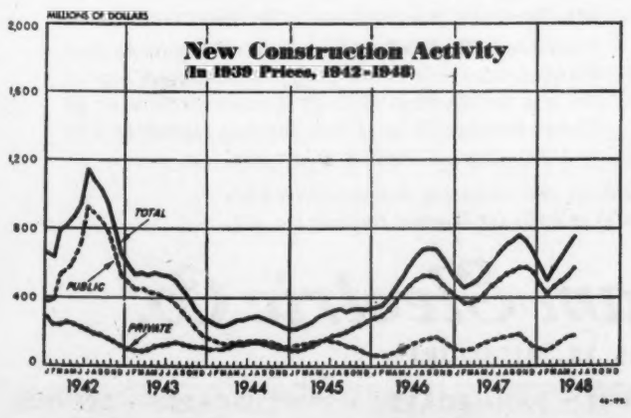
A-W Support

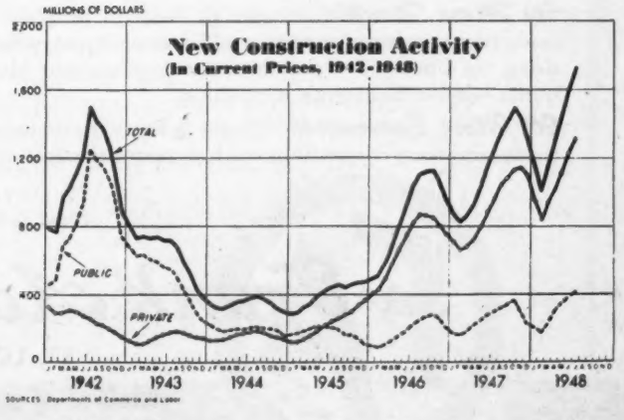
W. C. Johnson, president of the National Electrical Manufacturers Association is calling upon electrical manufacturers to launch employee educational programs on adequate wiring in their plants. Several companies have been carrying on extensive efforts to tell their employees about A-W and to show how it relates to their jobs.

Johnson's remarks are as pertinent for electrical contractors as for manufacturers. "All of us individually and collectively are dependent upon the electrical industry's prosperity. If the industry prospers, your company and my company prosper. And if our companies prosper, everyone connected with them benefits—executives, engineers, salesmen, clerical help and workers in the plant"—and we would add, contractors, estimators, superintendents, maintenance engineers, mechanics, foremen and time clerks. And we know of no program so vital to industry prosperity as A-W.

Residential Signalling

Are doorbells enough? A suitable device for informing the occupants that someone is at the door is only a tiny part of the potential market for residential signalling devices. Modern devices serve convenience, safety and security in the home in many ways. A. A. Schuhler discusses their application in his article on residential signals on page 64.





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REWIRING MARKETS

TWENTY PERCENT of current new construction volume is a conservative estimate of the parallel remodeling and alteration work in existing buildings. A similar percentage applied to new construction electrical work is, perhaps, far short of the actual volume of rewiring but it provides a useful reference point. For 1948 it is roughly $300 million.

DOLLAR VOLUME appraisal is only a partial picture of rewiring, however. As a market it differs in many ways from new construction. It is often negotiated work. Reputation, reliability, ingenuity and an extensive knowledge of materials and methods are better sales tools than the sharpened pencil. It is exacting work, requiring close supervision and an easy diplomacy, particularly in occupied premises.

IN REWIRING, the contractor is thrown upon his own resources much more than in new construction work. Specifications are necessarily flexible. Unforeseen obstructions and inaccessible spaces can alter major features of the work literally in a day's time. And the same flexibility is essential in materials handling and in methods.

MODERN CUTTING and fastening tools have greatly altered the rewiring market. Their effective and skillful use can cut the burden of cost in drilling, channelling and other mechanical work which has long been a serious deterrent to wiring modernization. Power drills and saws, tungsten-carbide cutting tools and many other devices are rewiring market builders of major importance.

KNOWLEDGE OF MATERIALS and ingenuity in adapting them to meet rewiring problems, however, is the most potent force that can be applied to developing the rewiring market. Multi-outlet assemblies, surface raceways, surface type fittings, compact panels for multiplying circuit capacity in existing cabinets, special raceways and wiring channels which fit inconspicuously into conventional architectural or decorative features of the space, are some of the specific materials that must become as familiar as pipe and wire.

AS A MARKET, rewiring is an important stabilizing influence in the industry. It suffers little from the chronic peaks and valleys of new construction. Weather is of little importance. The work can be paced at will to provide a steady labor curve or to absorb the labor fluctuations in other work. Rewiring is salable on the contractor's own initiative and the market potential is practically untouched. It has been submerged in the tremendous volume of new construction work in recent years, but it still persists as a great challenge to the electrical industry.

Wm. F. Stuart

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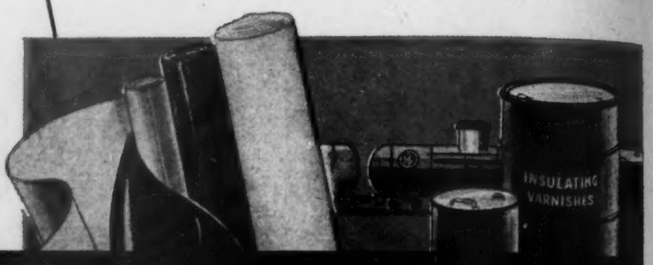

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Aerial view of ALCOA Davenport plant

ALCOA . . . OF DAVENPORT

Electrical installation at Aluminum Company of America's new 52-acre rolling mill features one of the first all-aluminum distribution systems in the country. High-voltage primary transmission loop and unique secondary low-reactance "sector" bus carry heavy currents for the 60,000 kw. connected load.

By J. Raymond Meehan

Vice-president, Fischbach & Moore, Inc., Chicago, Illinois

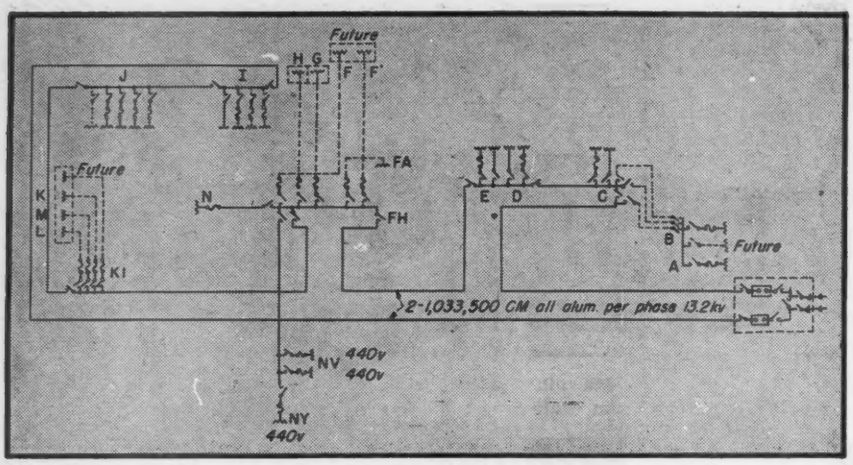
A FEW miles above Davenport, on the banks of the Mississippi river, a glistening new industrial plant is being completed on a 400-acre tract of Iowa farm land. It is the new 52-acre rolling mill of the Aluminum Company of America, designed to produce the widest sheet aluminum in the world. Basically an all-aluminum project (exception—structural steel building framework and steel transmission towers), it is ALCOA's answer to the application of aluminum in the industrial construction field. Even the four-mile chain-link fence surrounding the grounds is aluminum. Included in the project are 112 aluminum precision-built 3-bedroom homes being erected on a 50-acre site near the plant for sale to employees.

Every application of aluminum has been carefully engineered by ALCOA and the construction firms building the plant. Its use for building walls, roof, vents, doors, ducts, drains, flashing, hardware, electrical system, etc., had been specified only where particular advantages in weight, cost, physical properties, ease of erection, maintenance or other factors were indicated.

The same detailed engineering attention was directed to the plant electrical system. As a result, an all-aluminum distribution system was designed to serve the 60,000 kw. plant connected load (expected demand, 30,000 kw.). Installed on the project were approximately 1,800 miles of aluminum wire and cable (No. 12 to 1,250MCM); 106 miles of aluminum conduit (½-in. to 5-in.); 4.5 miles of flexible conduit (Greenfield); 46 miles of bare copper cable for outdoor underground grounding networks; and some 6,800 aluminum lighting fixtures. Biggest innovation was the design of a new aluminum low-reactance "sector" bus (triangular design) for heavy 440-volt feeders.

Reasons for going all-out on aluminum electrical distribution were deeper than a natural desire for ALCOA to use its own products. At the time construction started, aluminum cable enjoyed a price advantage over copper. A critical copper shortage existed—and still does. Improved methods for making connections to heavy aluminum conductors were available.

To Fischbach and Moore, Inc., electrical contractors on the project, this installation was a new experience. It meant training mechanics (average crew—215; peak—365) to use the latest cable terminal techniques; solution of many problems without benefit of previous experience with these materials; establishment of new man-hour data; site fabrication of the new bus; and the development of new techniques.



ONE-LINE DIAGRAM of 13.2-kv. primary distribution loop.

DISTRIBUTION

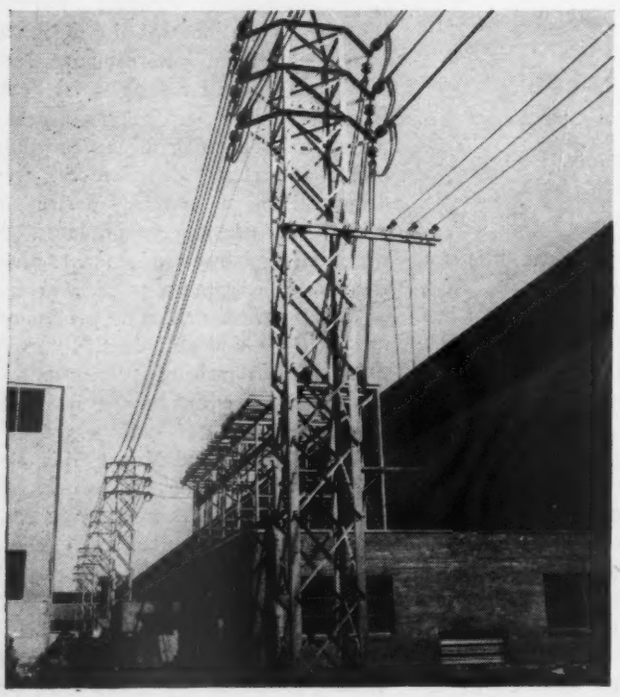
ELECTRIC power is supplied by two 13.2-kv. underground circuits from the Iowa-Illinois Gas & Electric Company's Riverside plant—a stone's throw from the mill site. These terminate in an outdoor switch structure of aluminum alloy erected near one end of the huge plant. From this point the circuits go overhead on transmission towers (six of them aluminum structures) that practically circle the plant to serve nine aluminum outdoor substation structures. Primary conductors consist of two 1,033,-500CM stranded all-aluminum cables per phase suspended from insulators by parallel-groove clamps. The two circuits are carried vertically on opposite sides of the towers; are closed at the remote end to form a loop which remains closed under normal operation.

Indoor unit-type substations are fed from the primary loop switching stations by single-conductor aluminum cables with oil base insulation, Neoprene jacket and aluminum tape shield (sizes—1/0, 4/0 and 750MCM). Secondary switchgear adjacent to outdoor substations are fed by aluminum bus connections.

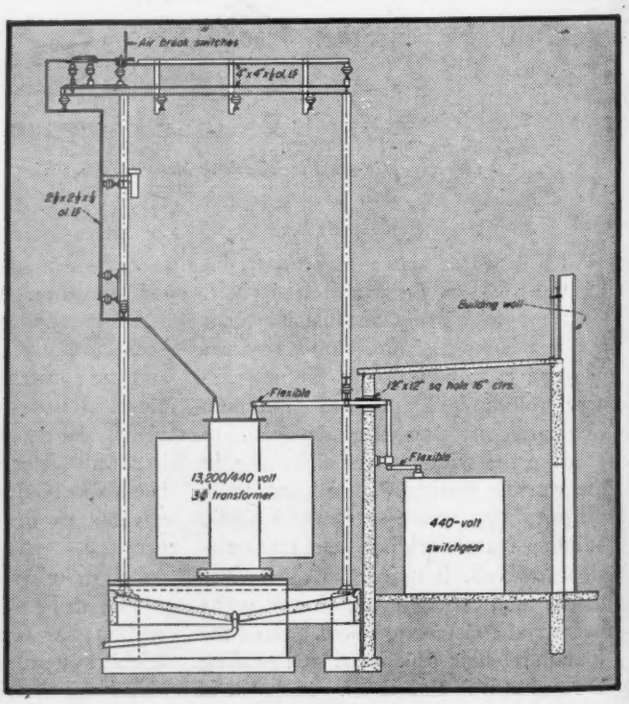
A number of outdoor substations supply 2,300-volt power to motors larger than 1,000 horsepower. These motors drive the motor-generator sets that supply direct current for motors on the roll stands. Each 2,300-volt motor is fed from a separate transformer tied to the 13.2-kv. loop through fuses and disconnect switches. Radial circuits from these transformers to the motor starting equipment (which includes a secondary breaker) consist of 1,000MCM and 1,250MCM stranded (Class C) aluminum cable with oil base insulation and Neoprene jacket. To minimize splicing, cables were ordered cut to specified length. Depending upon installation conditions, these circuits were run in aluminum troughs, aluminum ducts, or Transite ducts when underground.

Secondary Distribution

Fourteen substations of the outdoor and indoor type supply the 440-volt, 3-phase secondary distribution system serving the entire plant area. Largest concentrations of power are in the main 3,600-foot mill building where all motors of 1,000 hp. and less are operated on 440 volts. Substations are

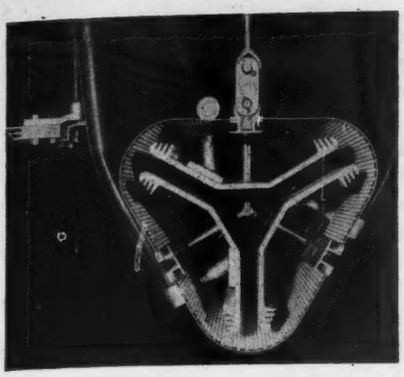


A PORTION of the 13.2-kv. distribution loop feeding two mill building substations. Both 2,300-volt and 440-volt is supplied.



DETAILS of a typical 13.2-kv. outdoor substation serving an adjacent indoor 440-volt switchgear unit.

. . . Alcoa of Davenport



SECTIONAL view of 3,500-ampere, 3-phase, 440-volt, aluminum sector bus.

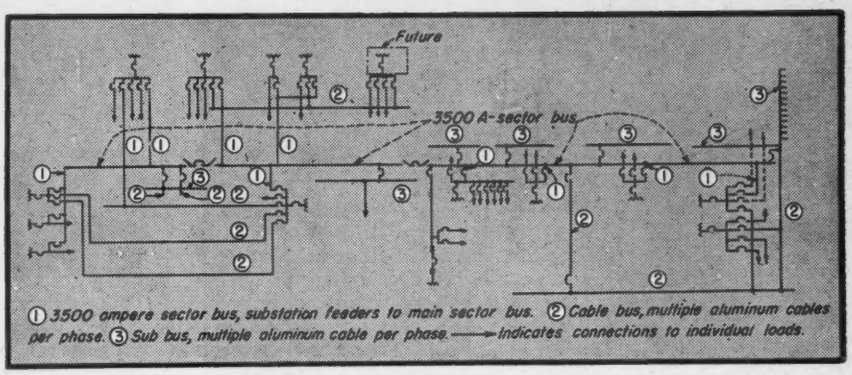
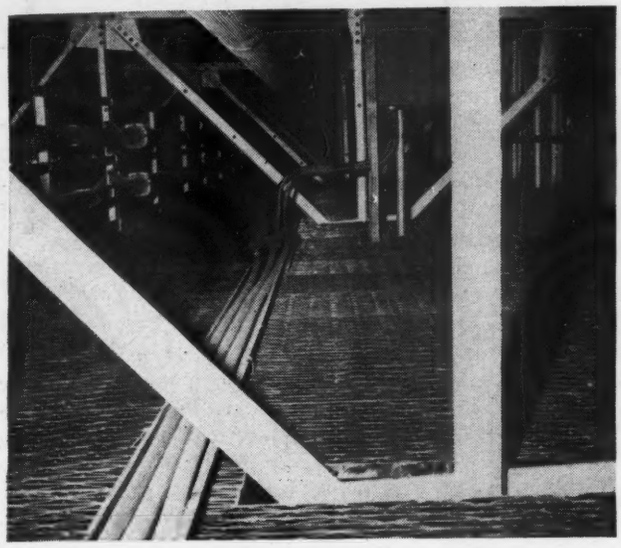
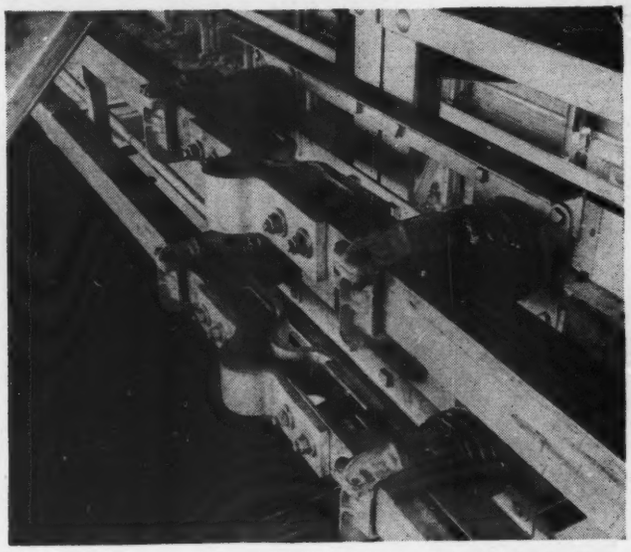

Future
3500 A-sector bus
① 3500 ampere sector bus, substation feeders to main sector bus. ② Cable bus, multiple aluminum cables per phase. ③ Sub bus, multiple aluminum cable per phase. ——→ Indicates connections to individual loads.

DIAGRAM of main 440-volt, 3-phase distribution showing application of sector bus, multiple aluminum cable feeders and sub-buses.



TYPICAL SHOT of mill catwalk showing main sector bus above; aluminum cable sub-buses on floor; d-c bus at left.



DETAIL VIEW of d-c bus expansion joint and mounting to catwalk rail.

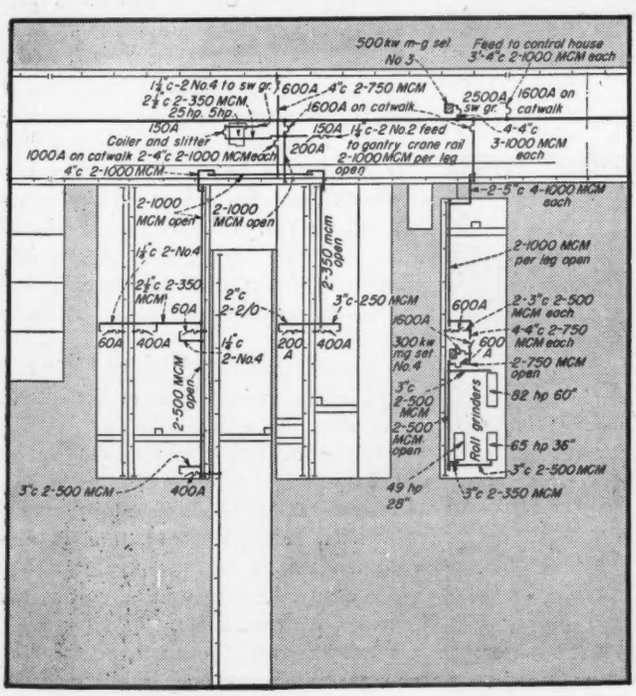
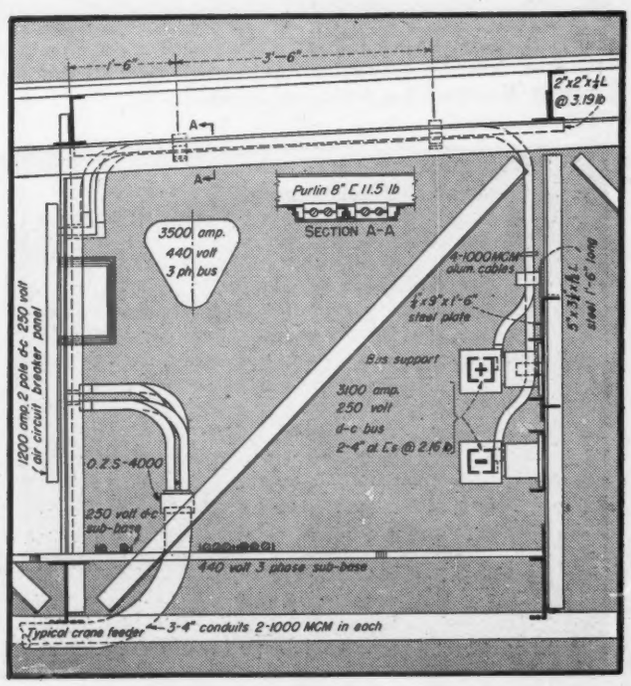


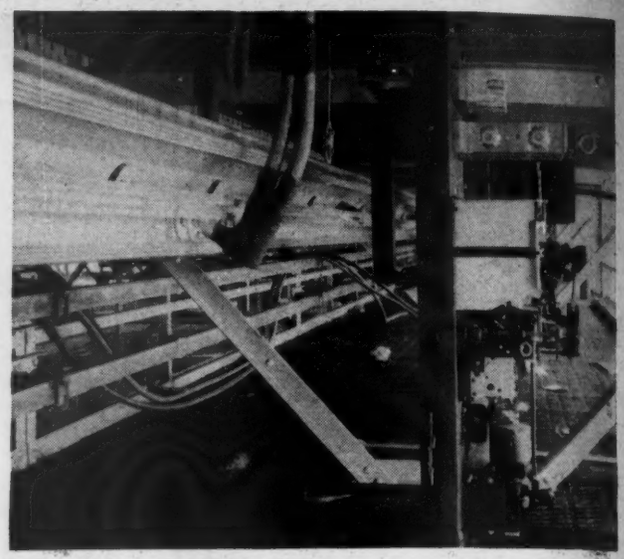
DIAGRAM of 250-volt d-c crane power distribution system showing main feeder bus in catwalk and open cable sub-feeders.


1'-6"
3'-6"
2"x2"x¼L @ 3.19 lb
A
Purlin 8" C 11.5 lb
SECTION A-A
3500 amp. 440 volt 3 ph bus
4-1000 MCM alum. cables
¼"x9"x1'-6" steel plate
5"x3½"x¼"L steel 1'-6" long
Bus support
3100 amp. 250 volt d-c bus 2-4" at Cs @ 2.15 lb
1200 amp. 2 pole d-c 250 volt air circuit breaker panel
0.2.5-4000
250 volt d-c sub-base
440 volt 3 phase sub-base
Typical crane feeder
3-4" conduits 2-1000 MCM in each

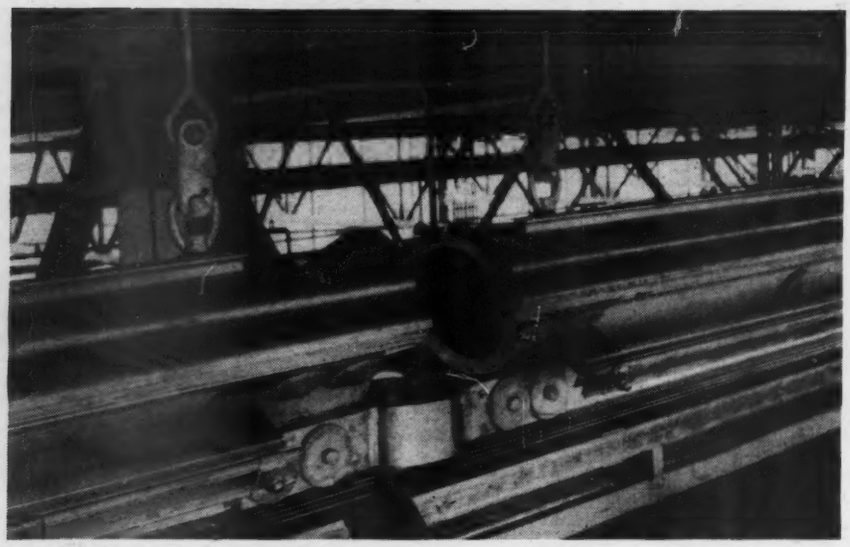
TYPICAL 250-volt d-c connections to catwalk bus. Open cable jumper bridges a-c sector bus to circuit breaker.

COMPARISON OF VARIOUS METHODS OF TRANSMITTING 3000 AMPS · 3 PHASE · 440 VOLT · 60 CY.	SECTOR BUS ASSEMBLY	6 ALUMINUM CHANNELS (WITH ENCLOSURE)	12 1000 MCM INSULATED ALUMINUM CABLES (OPEN)	21 1000 MCM INSULATED ALUMINUM CABLES (IN CONDUIT)
LINE TO LINE VOLTAGE DROP 1000 FT. RUN - 100% P.F.	21.5	47.5	33.0	16.8
LINE TO LINE VOLTAGE DROP 1000 FT. RUN - 80% P.F.	41.6	123.2	62.0	30.0
APPROXIMATE COST PER FT. INSTALLED.	100%	150%	100%	200%
APPROXIMATE WEIGHT PER FT. INSTALLED (LBS.)	23	35	25	100
APPROXIMATE SPACE REQUIRED (SQ. INS.)	180	360	220	240
EASE OF MAKING FUTURE TAPS	+	+	+	—
SAFETY TO PERSONNEL	+ +	+ +	+	+ +

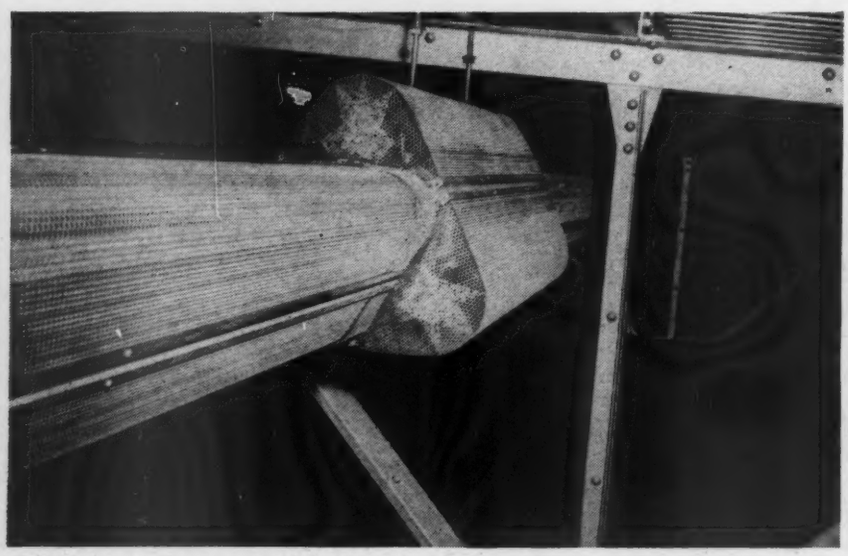
TABLE comparing features of sector bus with conventional conductors of equal current carrying capacity.



VIEW OF CIRCUIT BREAKER cable taps to sector bus showing special 30-degree offset lugs for parallel cables.



SECTOR BUS expansion joint of laminated sheet aluminum. Cover is removed to show flexible connection, suspension method and insulator extensions to support H-sections for perforated enclosure.



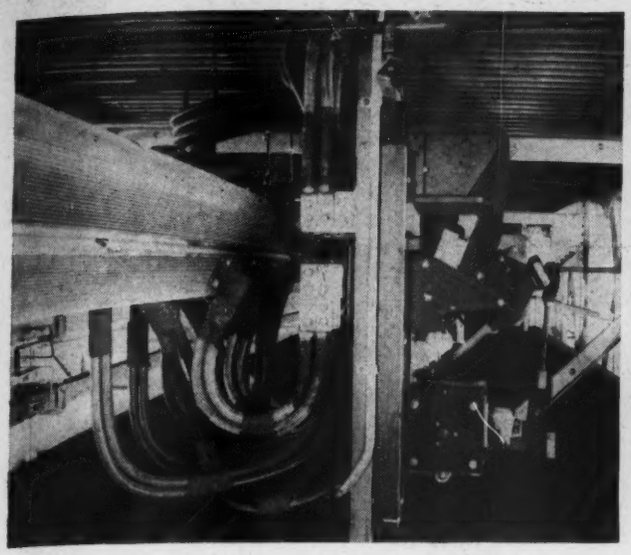
ENLARGED PERFORATED SHEET aluminum enclosure at sector bus expansion joint.

with lateral feeders serving power concentrations in other buildings. All substations have sufficient spare capacity to serve future loads in any of the buildings without the need of major changes.

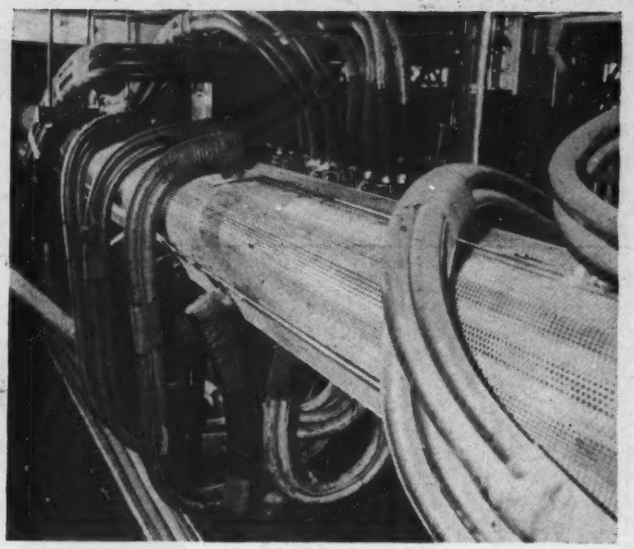
In general, main feeders, sub-feeders and motor circuits are run overhead to major control centers. Mill control equipment is mounted on mezzanine platforms with motor circuit conduits running underground to mill locations. Main feeder for the highly concentrated 440-volt loads is a 3,500-ampere, all-aluminum, specially designed low-reactance "sector" bus. A 3,500-foot run of this unique bus is mounted horizontally above a roof-truss catwalk in the main mill building. Another 1,400 feet are installed to feed two electric heat treating furnaces and as lateral connections in the bus system. The main bus is divided into three sections, each fed by at least two substations. Service continuity is assured by two 4,000-ampere sectionalizing breakers that tie the main sector bus sections; also aluminum cable bus interconnections between substation secondaries.

Heavy circuits are tapped directly to the sector bus through air circuit breakers. Smaller loads are fed, through breakers, from sub-bus cables fed by and paralleling the sector bus. These 1,000MCM aluminum, Neoprene jacketed cables are run open in aluminum troughs on the catwalk grating. All connections to the sector bus are made with open cable.

Feeders from the main sector bus to areas remote are open cables (one or more 1,000MCM aluminum cables) mounted on porcelain insulators in the

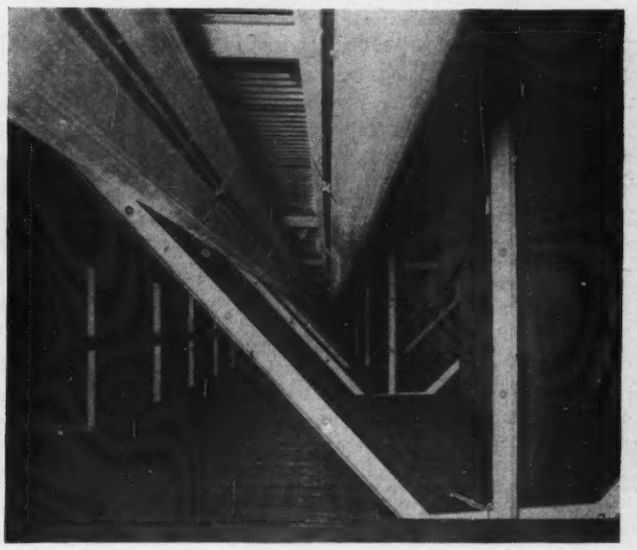


ONE OF THE 4,000-ampere sectionalizing breakers on the main 440-volt sector bus catwalk feeder.



ALL CONNECTIONS to sector bus are made with special argon-welded offset lugs and open aluminum cables.

SUBSTATION ALUMINUM CONDUIT and cable feeders to dual 3,500-ampere sector bus feeders for electric furnaces.



DUAL 3,500-ampere sector buses in catwalk feed two electric furnaces.

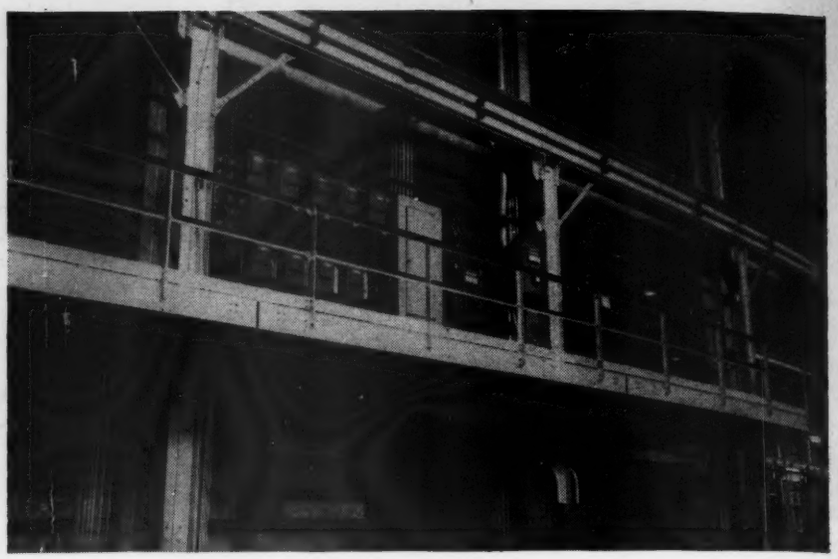
GROUP OF ALUMINUM CONDUITS in mill room floor to feed motors and controls.

OPEN FEEDERS of multiple aluminum Neoprene jacketed cables feed load concentrations at points remote from bus.

WEIGHT COMPARISON OF STEEL AND ALUMINUM CONDUIT—TABLE II

(Both of same diameter and wall thickness)

Size	Weight—Pounds Per Foot Steel	Aluminum	Weight Advantage of Aluminum Pounds Per 10-Ft. Length
½"	0.852	0.303	5.49
¾"	1.132	0.404	7.30
1"	1.684	0.601	10.83
1¼"	2.281	0.819	14.62
1½"	2.731	0.982	17.49
2"	3.678	1.327	23.51
2½"	5.819	2.099	37.20
3"	7.616	2.759	48.57
3½"	9.202	3.323	58.79
4"	10.899	3.945	69.54
4½"	12.642	4.600	80.42
5"	14.810	5.432	93.78
6"	19.185	7.017	121.68



MEZZANINE MOUNTING of electric controls for mill motors and auxiliaries.

roof trusses and dead-ended (with a light strain) on cross trusses. Such cable buses are fed either directly from the substations or from the main bus in a network arrangement. All connections to power sources are made through air circuit breakers.

Sector Bus Design

The unique all-aluminum sector bus was designed by ALCOA engineers to provide an economical means of transmitting large blocks of secondary current with a minimum of transmission losses. To obtain minimum (one-inch) spacing of conductors for low reactance, a triangular design was used. Each of the three bus conductors is an 11/32-in. by 12½-in. wide extruded aluminum shape (sector) with 120-degree "wings". Four fins on the edge of each wing help dissipate heat, increase stiffness and distribute cross-sectional area.

CATWALK IN MILL building roof trusses provides easy access to sector bus, branch circuit breakers, and d-c bus. Sub-feeder conduits leave top and bottom of catwalk.

When assembled, the three sectors form a central triangular web in which, at intervals of one to four feet (depending upon anticipated short circuit stresses), are three-legged supporting Bakelite insulators. Every 10 feet, these insulators have extended legs to support the triangular ⅛-inch thick by 12-foot long perforated sheet aluminum enclosure (fabricated in three segments that snap into grooved, aluminum H-strips). Every 20 feet, the top leg of the insulator is equipped with an eye to accommodate a double-clevis vertical suspension rod. Special Neoprene washers in the insulator design (next to the outer face of the bus sector) relieve peak short circuit stresses considerably by permitting slight movement of the conductors.

Natural ventilation of the bus is assured by having one of the three sector separations at the bottom of the assembly and using the perforated enclosure. Aluminum splice plates are used to connect each sector of the 40-foot lengths together to form a continuous run. Special high-strength bolts, spline nuts and spring washers assure tight connections.

Flexible, laminated sheet aluminum expansion joints are installed at 120-foot minimum intervals in the sector bus run. Larger section perforated enclosures are used at these expansion points. The double-clevis type hangers also take up some of the movement that may arise from the differential expansion of bus and building structure. Special 800- and 1,600-ampere, 30-degree aluminum alloy lugs with flexible aluminum Neoprene insulated cable provide tap-off facilities to the sector bus feeder.

System

Service for approximately 2,000 kw. of 250-volt direct current equipment—traveling crane motors, auxiliaries on all mills, and other d-c machines—is provided by two 500-kw. and four 300-kw. motor-generator sets located at heavy load centers. These feed a 3,500-foot run of 4-inch double aluminum channel bus mounted to the inside of the catwalk rail by fixed and roller type bus supports. Rated at 3,100 amperes, this bus parallels the 440-volt, 3-phase sector bus suspended from the roof structure over the same catwalk. D-c tap-offs are confined to areas where no a-c branches occur.

Aluminum conduits with aluminum cables (two to five 500 to 1,000MCM cables per leg according to load) provide the connections between motors, switchgear, generators and the d-c bus. Open cable jumpers, bridging the sector bus, tie the branch circuit breakers to the d-c bus. Typical crane feeders from the catwalk breakers consist of aluminum cable in aluminum conduits (one or more 1,000MCM cables per leg) that pass through the catwalk floor. Heavy branch circuits are fed directly from the bus; smaller loads are tapped off open aluminum cable sub-buses in aluminum troughs on catwalk floor, similar to a-c scheme.

INSTALLATION TECHNIQUES; ECONOMICS

THE all-aluminum distribution on this project introduced techniques new to the electrical construction field.

Compression type connectors and lugs were used on all cables up to and including 350MCM size. On larger conductors, argon-shielded arc welding was employed. This process requires no flux; uses a tungsten electrode, 2S aluminum welding wire and an envelope of inert argon gas (coming from the tip of the electrode holder) that protects the white metal during the welding process. The lugs have sleeves open at both ends to form a cup when slipped over the cable. After the cable strands have been fused together and bonded to the sides of the lug, the cavity is filled with the welding wire to make a permanent bond.

Aluminum cables of No. 6 and larger have Type RH insulation; No. 8 and smaller, Type RU. Current carrying capacities of RH aluminum cables are essentially the same as those of the same size Type R copper conductors now in use. To allow for voltage drop, aluminum cables are on the average one size larger than would have been needed if copper had been used. The non-magnetic features of aluminum conduit raceways permitted a reduction in reactance losses (over steel conduit) on heavy current capacity circuits; in addition, fanning of cables at terminals may be eliminated since conductors of one phase may be carried in a single conduit.

An inhibiting joint compound was used on both the aluminum to aluminum and aluminum to copper (at motor terminals and switches) connections. Where lugs were exposed to corrosive atmospheres, the completed joint was protected by NO-OX-ID compound. All open cable connections were taped and painted with a coat of Glyptal.

Field Fabrication

Considerable field fabrication was necessary on this project. The use of oversize aluminum cables required larger pull boxes in the conduit runs and larger terminal boxes on motors, switches and controls. Circuit breakers up to 600-ampere rating were ordered with box and terminal extensions to accommodate the right-angle compression lugs used on the cables. Motor terminal and conduit pull boxes were fabricated of aluminum to field dimensions and installed on the job.

The 3,500-ampere sector bus was completely assembled on a fabrication line at the job site. The 40-foot "winged" sector extrusions were delivered to the job with pre-drilled holes for center insulators (every two feet). Other holes for cable taps, splice plates, etc., were drilled on the job and complete assembly of sectors, insulators and enclosure supporting strips was done in the field.

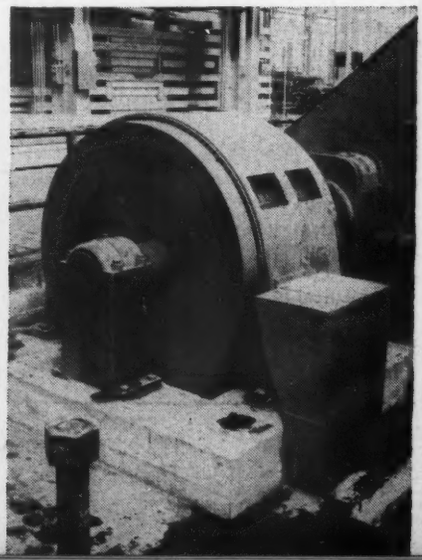
Electricians on the project claimed that aluminum conduit, cable and bus

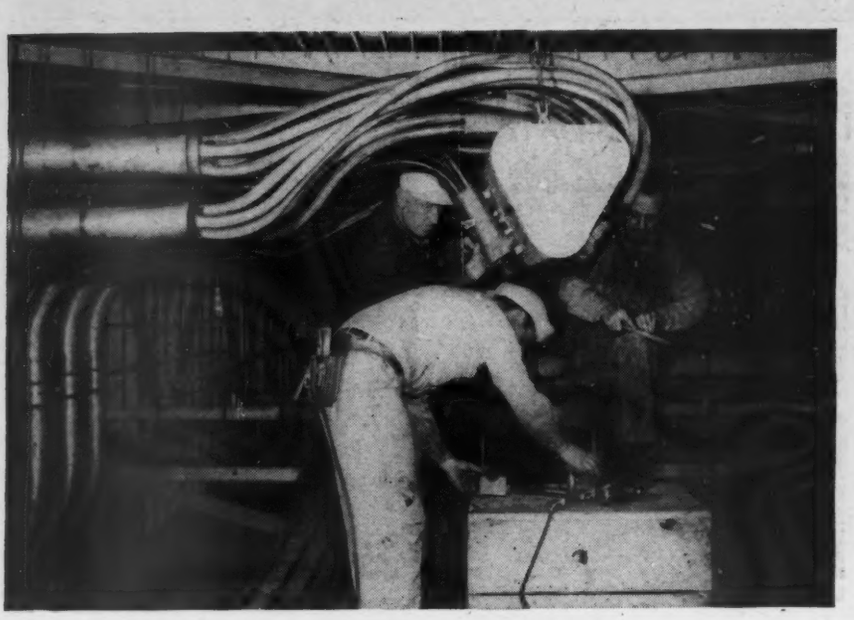
LUGS on aluminum cables above 350 MCM are permanently bonded by argon shielded tungsten arc welding. Vise plates grip conductor, dissipate heat. Complete welding unit is portable.

LUG on a 500MCM aluminum cable showing pocket that is filled with metal when welded.

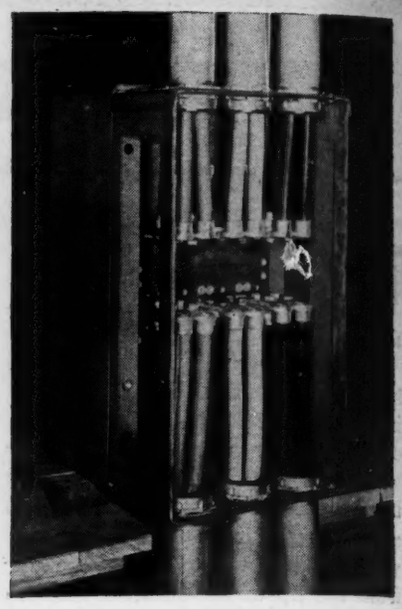
PART OF THE SECTOR BUS assembly line where aluminum extrusion sectors are drilled for cable taps and splice plates. Carbon tetrachloride is used as lubricant.

OVERSIZE aluminum cables require large motor terminal boxes similar to this on an 800 hp. induction motor.

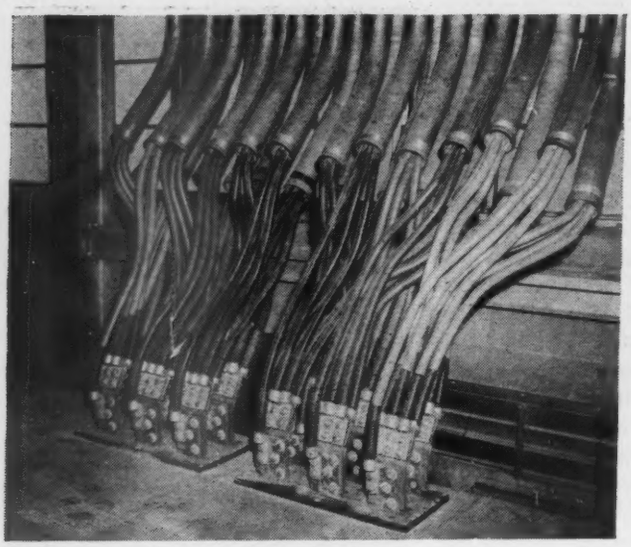




PUTTING THE FINISHING TOUCHES on multiple aluminum cable feeders to 3,500-ampere sector bus lateral over a unit substation.



TYPICAL circuit breaker showing enclosure and terminal extensions to accommodate aluminum cable and special lugs.



EIGHTY-FOUR 1,000MCM aluminum cables (seven per leg) leave 24 aluminum conduit risers above double unit substation. Each terminal has seven cables.

DEAD-ENDING six 1,000MCM aluminum cables in open roof truss run. Special lugs provide for jumper tie to continuation of run behind mechanic.

FIELD PERSONNEL

FISCHBACH & MOORE, INC.

Project Manager —Joseph Benson
Chief Engineer —I. E. Dischinger
Construction Supt.—Frank Deluhery
Office Manager —T. H. Deevers

ALUMINUM COMPANY OF AMERICA

Electrical Engineer—Charles Stoughton
Construction Supt.—H. F. Robey

are easier to install (with the exception of terminals) than steel and copper, primarily because of the light weight of the material. Aluminum is easier to cut, thread and bend than steel, hence is easier on expendible tools. Standard pipe dies were used on the smaller sizes; larger ones were reground with an increased "hook" or "rake" (35-degree angle) to make them self-cleaning.

After some experimentation, mechanics found that the following techniques worked best with aluminum:

1. A tallow candle is the best sawblade lubricant for cutting.

2. Carbon tetrachloride is the best lubricant for drilling.

3. Standard cutting oil works well on threading.

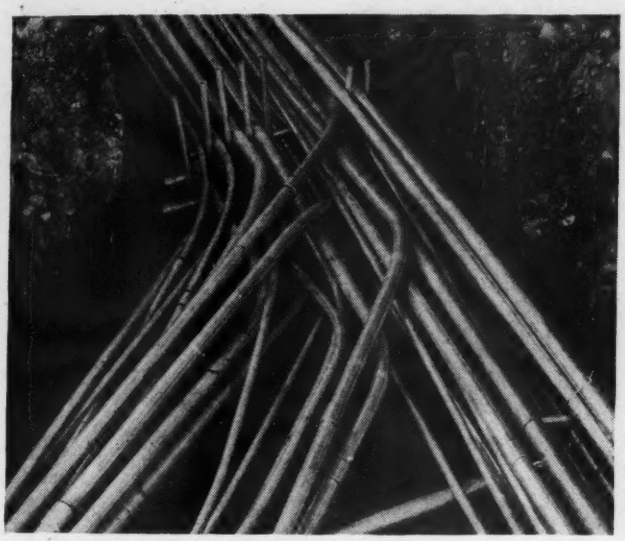
4. Points of drills are ground down similar to those of wood bits so the outer edges cut first and end up with a "penny".

5. A bronze ball brazed on the end of a steel fish tape facilitates pushing it through aluminum conduit.

6. Aluminum conduit bends must be made "on the nose". The material does not spring back like steel. Standard hickeys and benders are used. Fewer mechanics are required on heavy conduit.

ALUMINUM CONDUIT bends are easy to make; must be "on the nose". Two men can handle any large size conduit.

LIGHT WEIGHT of this 1,000MCM Neoprene jacketed cable makes for easy handling in roof truss pulls.



GROUP OF ALUMINUM CONDUITS in open trench for underground run. Note use of conduit lengths for racking and spacing stakes.

LIGHT WEIGHT of aluminum conduit makes a hit with electricians. Total weight of these two 4½-inch lengths equals that of one length of 3½-inch steel conduit.

7. A damp cloth is the best cable lubricant for Neoprene jacketed conductors.

Aluminum rigid conduit according to the manufacturers can be installed underground, in concrete and foundations, overhead, exposed and through underflooring. Only precaution is that no alkaline material come in contact with unprotected aluminum conduit. Although the smooth inner wall of aluminum conduit causes greater frictional resistance to Neoprene jacketed cable pulling, this condition is now being remedied by the manufacturers.

By using aluminum conductors, the owners estimate a saving of approximately one-quarter million dollars in cable cost alone (based on prices prevailing at time of purchases). Estimates also indicate that the cost of the sector bus installed is the same as that for open aluminum cables and one-half that of aluminum cables in conduits (comparable capacities).

Biggest advantage aluminum offers is its light weight. Aluminum conduit weighs about one-third that of steel conduit of same size and thickness; the weight ratio for the same current carrying capacity of aluminum and copper bus bars is about 50 percent; that for the larger cables used, about 45 percent.

Since a considerable portion of installation labor goes for handling materials, this weight advantage of aluminum is reflected in a lower *overall* labor cost. Records, to date, indicate a saving of as much as 30 percent in labor (based on conventional materials and installation).

Electricians on the Davenport project say they like to work with aluminum. It takes the drudge out of heavy electrical construction. Conduit and cable is easier to transport and handle, especially on overhead work. As several mechanics expressed it, "Working with this material is adding years to my productive life".

SALESMANSHIP IN ACTION is observed when A. J. Shimer, Crowder sales engineer, takes student on field trip.

MOTOR REPAIRING is explained to Robert Brokloff, Allentown Junior student, during 5-day program.

ORIENTATION ON THE JOB

Training program for high school students, sponsored by contractor H. N. Crowder, earns civic recognition; discovers promising personnel.

By Hugh P. Scott

In the offices and shops of the H. N. Crowder Jr. Company in Allentown and Easton, Pennsylvania, technical high school students receive comprehensive, intensive, practical training in electrical contracting, service and supply. With the approval of the Board of Education each student spends a week in the Crowder organization, on the payroll, earning while learning.

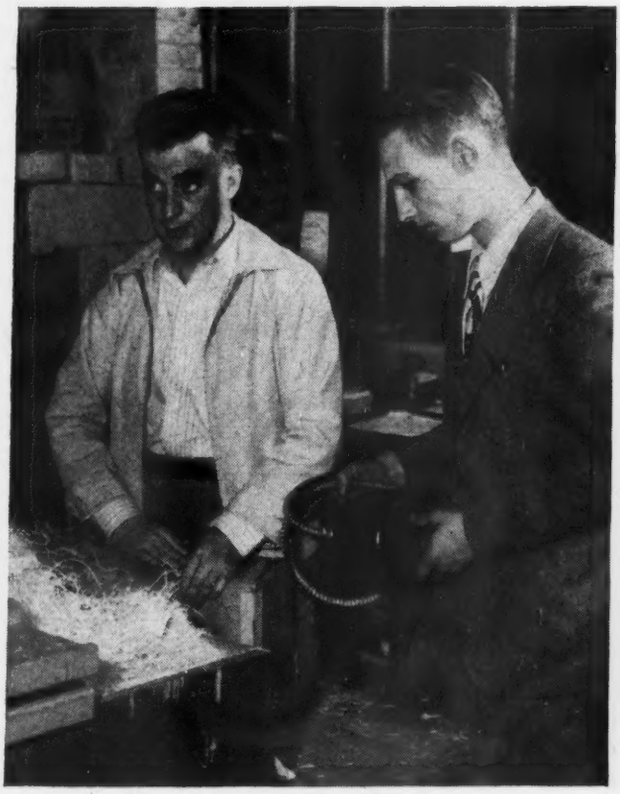
The course is comprehensive—presenting to the student a complete picture of business management, electrical engineering, field construction, motor maintenance and repair, specification and procurement of materials, shipping, bookkeeping and salesmanship. Training is thorough, including demonstrations of technique and procedure, interviews and discussions, manual practice and analysis. Under trained supervision students wind motors, wire switchboards, operate power tools, pack materials and equipment for shipping, check wiring diagrams and study specifications. The course is not confined to a single organization, for students accompany salesmen on trips to a variety of plants. They ride with maintenance crews on emergency calls; inspect construction projects in progress; follow shipments from stockroom to installation sites in mills, factories and offices. They talk with plant managers, engineers, maintenance men and purchasing agents. They see electrical equipment in operation under a wide range of conditions in a variety of industrial and commercial locations. They meet leaders in commerce, industry, education and the professions by accompanying Crowder executives to civic luncheons. Through such contacts they not only learn the aspects of a comprehensive electrical company but also discover how the company is related to the electrical industry, and how the industry fits the economic pattern of the community.

Each week during the school term a different student is selected for orientation. For five days he observes, accompanies and aids regular employ-

[Continued on page 96]

SMALL MOTORS are tested, stripped and repaired by R. Lehr while trainee assists him in typical operations.

COIL WINDING mechanics, including spreading, dipping and baking, are demonstrated by Mrs. Edith Brown.



PACKAGING AND LABELING equipment for shipping, under guidance of Robert Maher, is included in course.

DICTAPHONE REPORT of impressions reveals reactions and benefits derived by student during week's orientation.

Cost Factors For Cables . . . Part II

Continuing the analysis of installed cost factors for cable applications. This article provides data on RH and other cable types.

By H. J. Finison

In Part I charts of installed cost and of installed cost plus capitalized losses were given for Type R cable. Similar charts are shown in this part for the other commonly used cable types. (Figs. 6-10)

Division of Costs

The allocation of total cost of a cable installation to the several factors contributing to the total will be of interest. Fig. 11a shows such a cost breakdown for Type RH cable based on installed cost with capitalized losses at $80 per kilowatt as assumed for the data presented in Figs. 5-10. This chart is obtained by connecting the unit cost for the different size cables at their maximum current rating. Fig. 11b gives the same information with the capitalized losses computed at a higher figure of $240 per kilowatt based on a 24-hour 6-day week operation with energy costs of 0.8 cent per kilowatt hour. Fig. 11c shows a similar allocation of cost for interlocked armor cable.

Comparison of Cable Types

While comparison of cable types is not a primary purpose of the data presented, some general conclusions are indicated.

Fig. 12a shows a comparison of installed cost based on the unit cost of the different cable sizes at their rating. Fig. 12b shows a similar comparison of installed cost plus capitalized losses.

These curves illustrate the lower cost achieved by use of interlocked armor cable. It should be remembered that this was an assumption based on general information, and the comparison here does not necessarily demonstrate the full extent of the saving in many applications.

Of cables installed in conduit, the Types V and RH show good comparative economy in spite of the lower cost of the cable itself for Type R. This is primarily due to the higher current-carrying ability of these cables due to the higher permissible copper temperature permitted by the varnished cambric and heat resistant rubber insulation.

The relatively high cost of Type T, Flamenol, is indicated for larger cable sizes, although it shows good economy for small sizes wherein lies its best application; although it may also be required due to its ability to withstand oils, acids, and alkalies.

It must be remembered that these cost factors are only one of the influences in choice of cable type. Each of the different types have a specific application purpose, depending upon conditions under which it is to operate. As shown by Fig. 13, two cable types may be combined in a single installation to gain advantages of each type.

TYPE RH—VERSATOL GEOPRENE

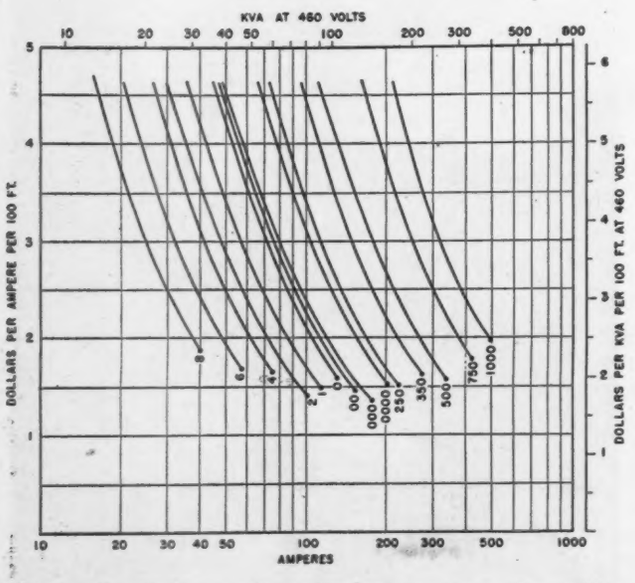


FIG. 6a.—Installed cost. Type RH 600-volt power cable. Three single conductor cables in steel conduit.

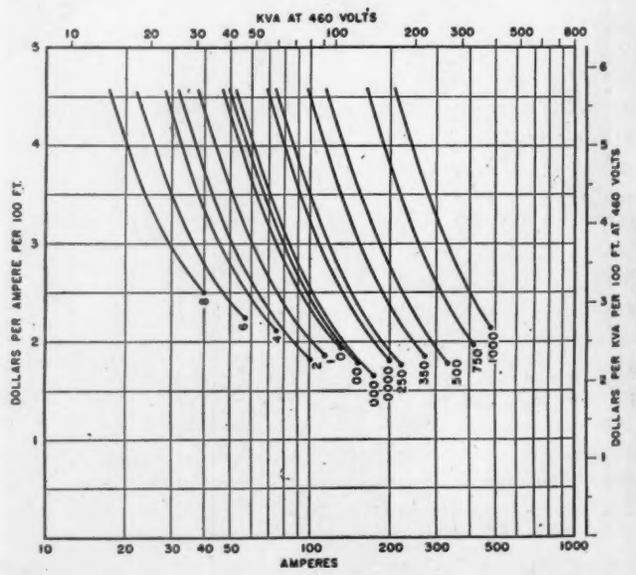


FIG. 6b.—Installed cost plus capitalized losses Type RH 600-volt power cable. Three single conductor cables in steel conduit.

FIG. 6.—Cost estimating data for low voltage power distribution cable. (Includes all material and labor for installing in a typical factory building. Numbers on curves are cable size AWG or MCM).

TYPE V—VARNISHED CAMBRIC

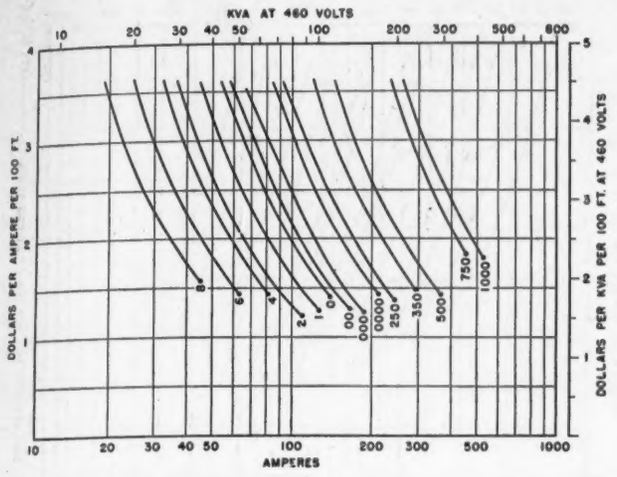


FIG. 7a.—Installed cost. Type V 600-volt power cable. Three single conductor cables in steel conduit.

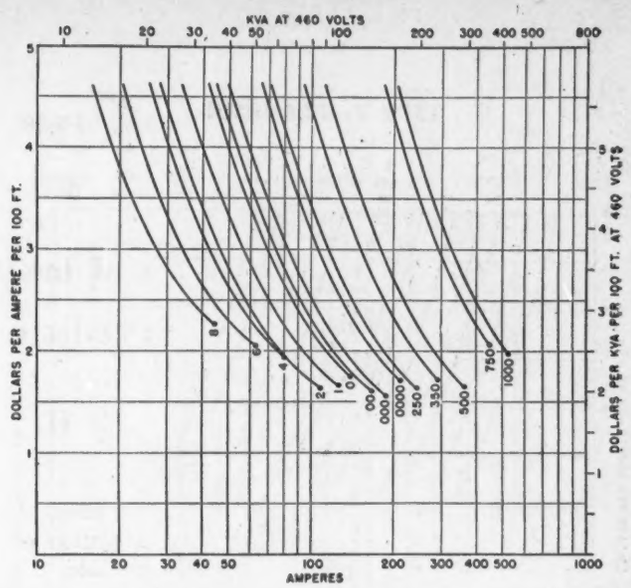


FIG. 7b.—Installed cost plus capitalized losses Type V 600-volt cable. Three single conductor cables in steel conduit.

TYPE VL—VARNISHED CAMBRIC—LEADED

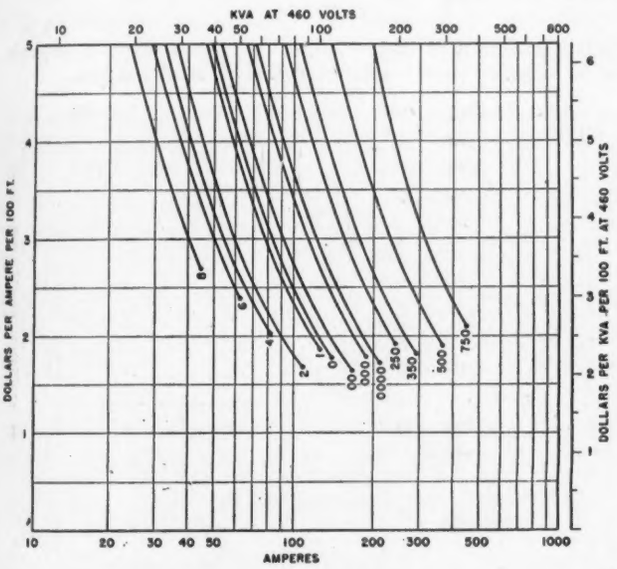


FIG. 8a.—Installed cost. Type VL 600-volt power cable. Three single conductor cables in steel conduit.

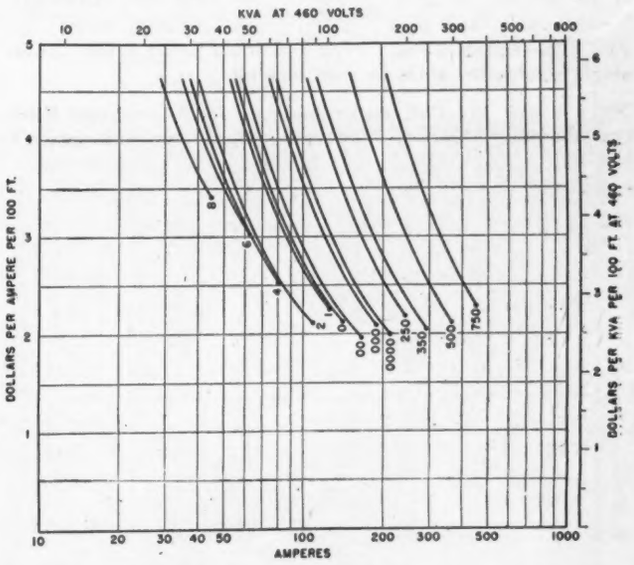


FIG. 8b.—Installed cost plus capitalized losses varnished cambric leaded power cable type VL 600-volt.

FIGS. 7 and 8.—All material and labor for installing cable in a typical factory. Numbers on curves are cable size AWG or MCM).

TYPE ACV—INTERLOCKED ARMOR

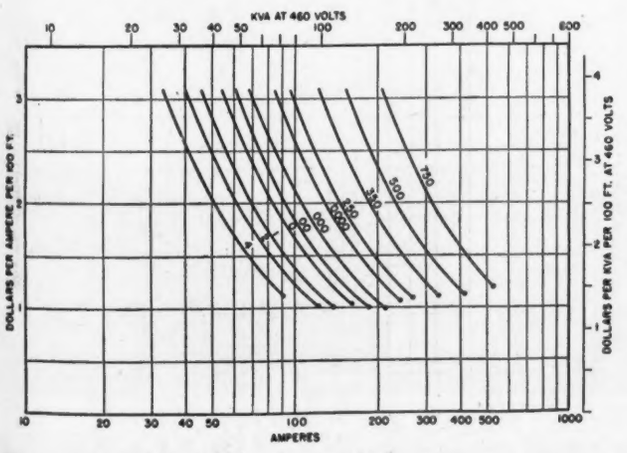


FIG. 9a.—Installed cost. Type ACV 600-volt interlocked armor power cable.

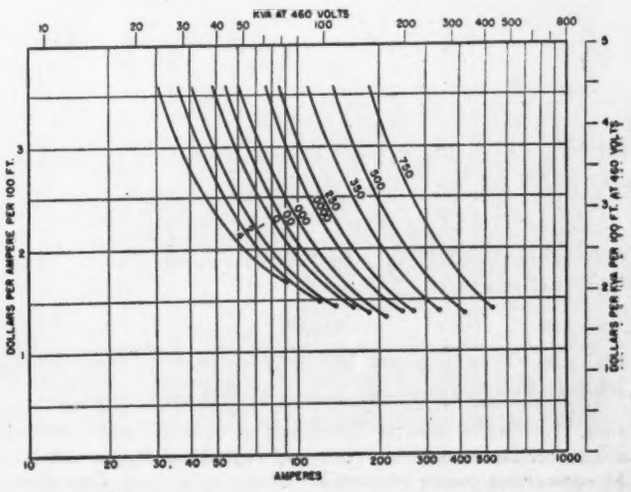


FIG. 9b.—Installed cost plus capitalized losses Type ACV 600-volt interlocked armor power cable.

TYPE T—FLAMENOL

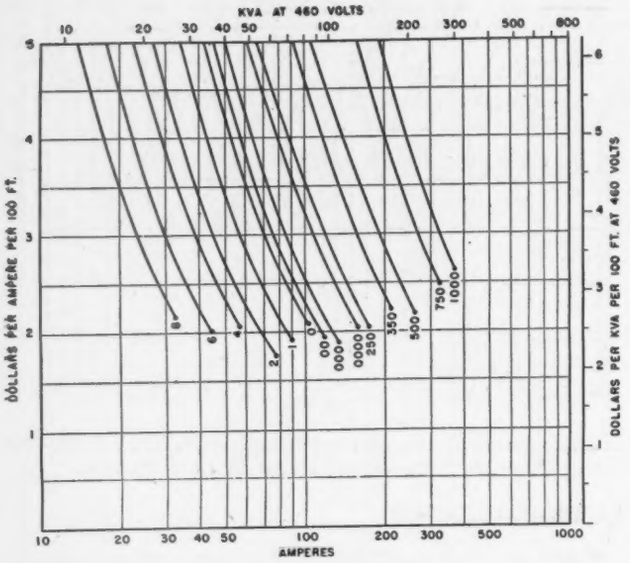


FIG. 10a.—Installed cost. Type T 600-volt power cable. Three single conductor cables in steel conduit.

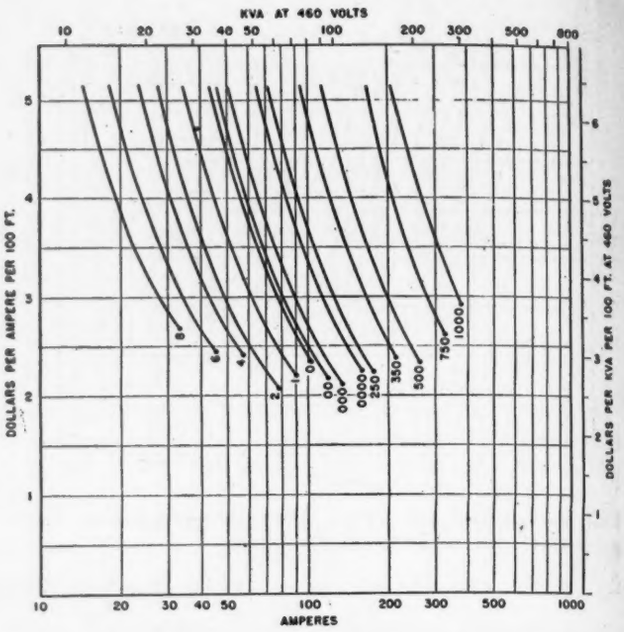
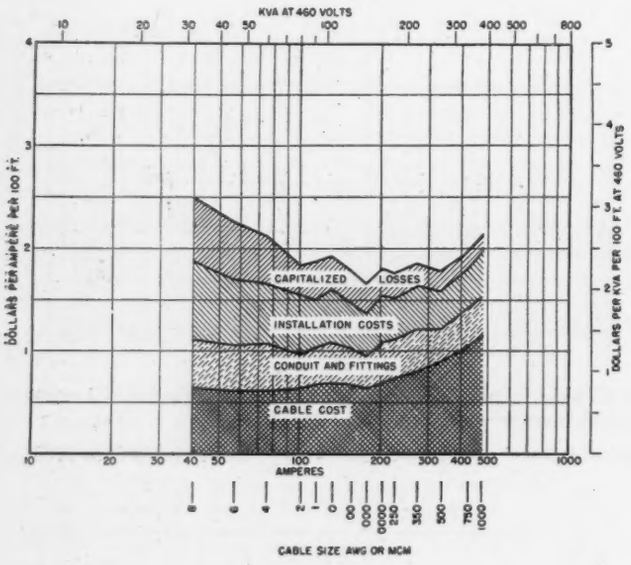
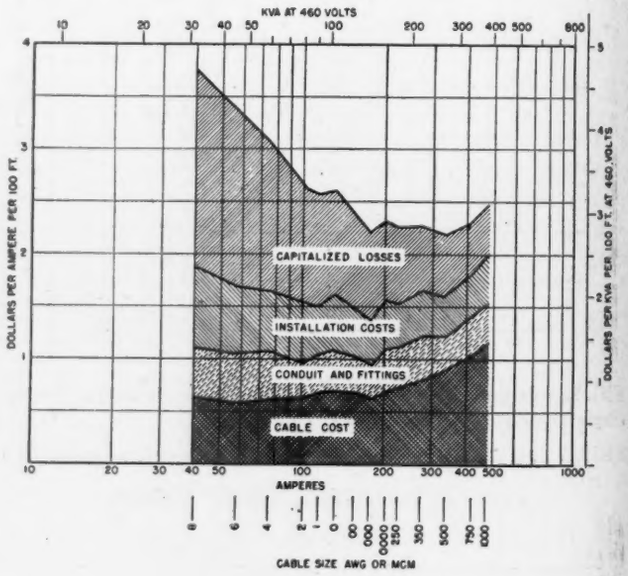


FIG. 10b.—Installed cost + capitalized losses Type T 600-volt cable. Three single conductor cables in steel conduit.

FIGS. 9 and 10.—Cost estimating data for low-voltage distribution cable. (Includes all material and labor for installing in a typical factory building. Numbers on curves are cable size AWG or MCM).





ABOVE

FIG. 11a.—Type RH Versatol Geoprene cable. Losses capitalized at $80 per kw.

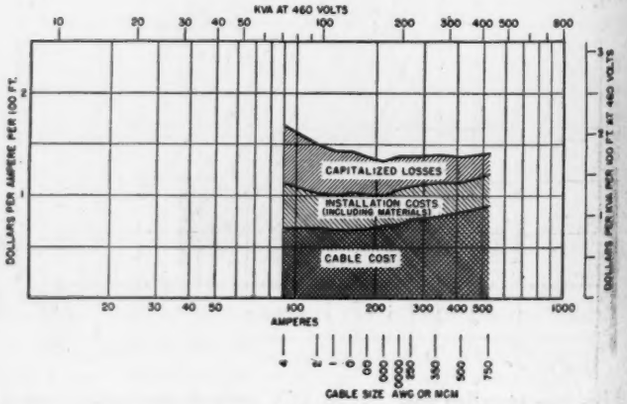
ABOVE RIGHT

FIG. 11b.—Type RH Versatol Geoprene cable. Losses capitalized at $240 per kw.

RIGHT

FIG. 11c.—Type ACV interlocked armor cable. Losses capitalized at $80 per kw.

FIG. 11.—Charts showing allocation of costs to cable, conduit and materials, installation costs and capitalized losses, obtained by connecting points of costs at cable rating from data shown in Fig. 5. Numbers on curves are cable size AWG or MCM.


KVA AT 460 VOLTS
DOLLARS PER AMPERE PER 100 FT.
DOLLARS PER KVA PER 100 FT. AT 460 VOLTS
CAPITALIZED LOSSES
INSTALLATION COSTS (INCLUDING MATERIALS)
CABLE COST
AMPERES
CABLE SIZE AWG OR MCM

INSTALLED COST COMPARISON

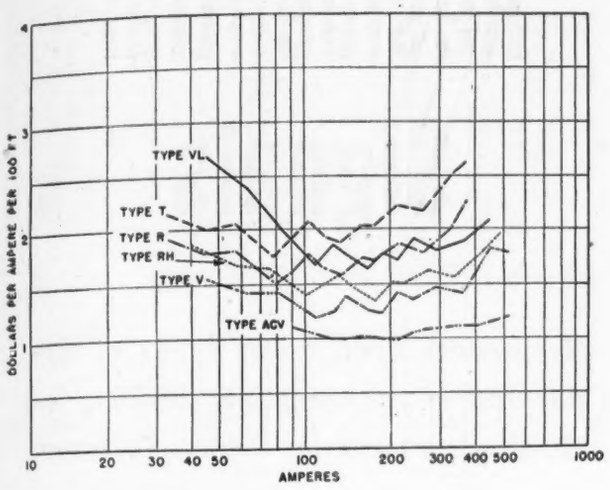


FIG. 12a.—Installed cost.

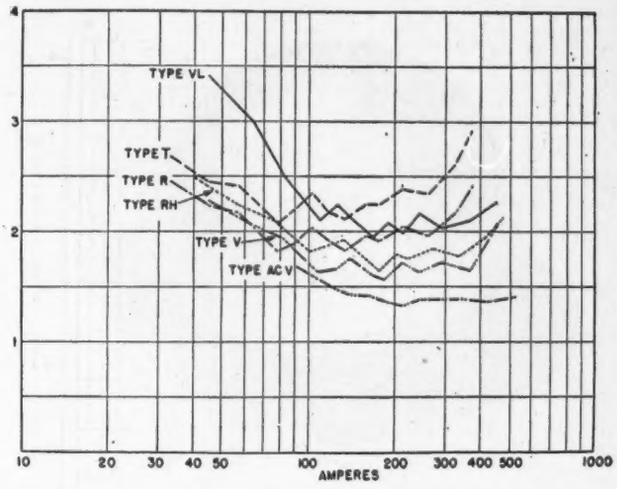


FIG. 12b.—Installed cost plus capitalized losses.

FIG. 12.—Comparison of cable types obtained by connecting points of unit cost at cable rating from Figs. 5 to 10.

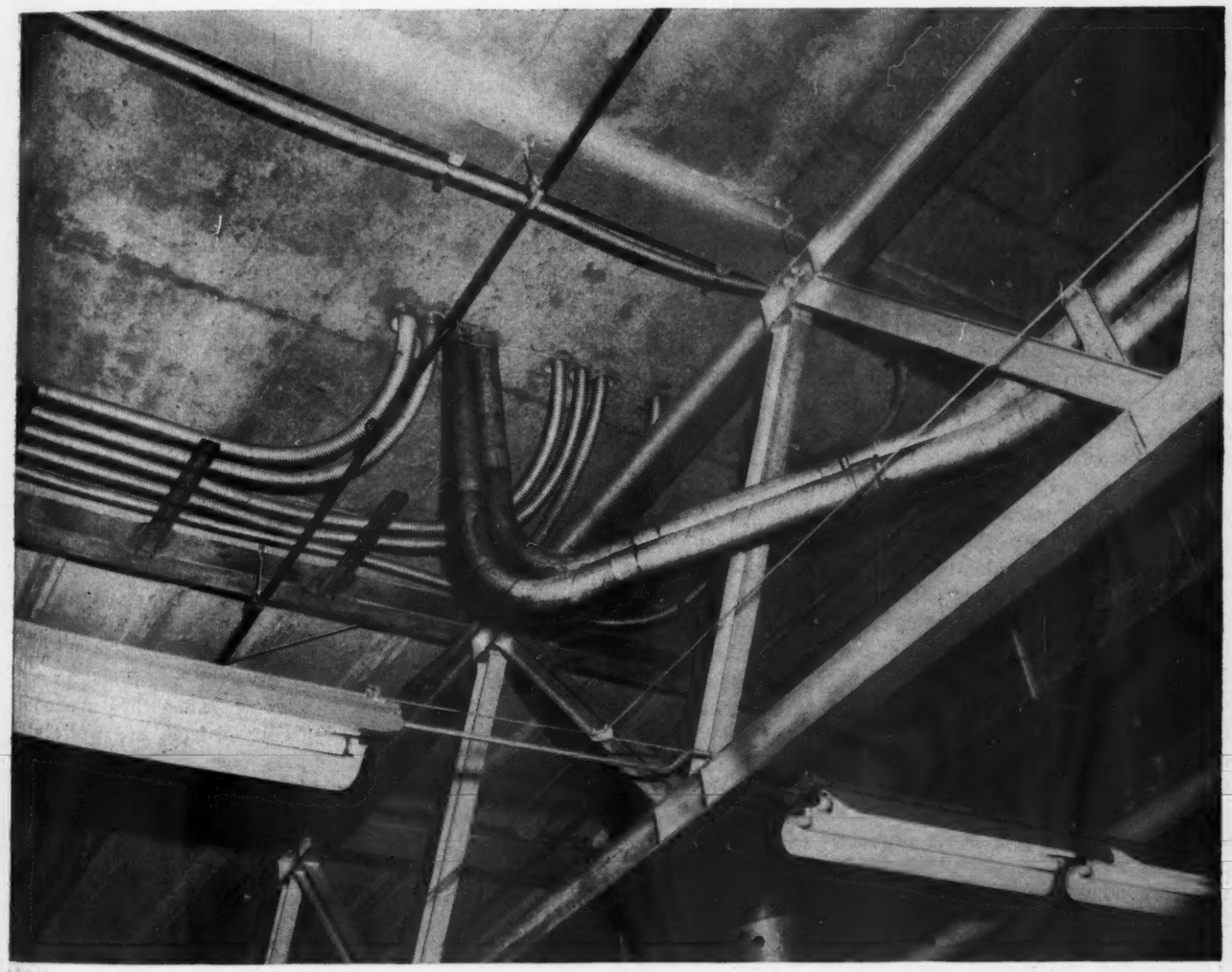


FIG. 13.—Cable dropping down through ceiling in factory where unit substation is located on roof. Shows use of both interlocked armor cable and varnished cambric braded in conduit.

FIG. 1—Thermostatic fire detectors spot high temperatures or rapid temperature change.

Residential Signals

Residences need many types of signal and communication devices, including automatic safety features.

By A. A. Schuhler

THE modern residence whether located in an urban or suburban area is a worthy prospect for signaling and communication systems. The trend of the times is reflected in a growing demand for all types of appliances, lighting fixtures, radio and television sets for the convenience and entertainment of the owners and their guests. Signal systems offer tremendous opportunities not only for the convenience of the owners and users, but in constantly safeguarding the lives of all who dwell therein and in protecting the contents of the home.

In most of the small and medium sized residences, many of the owners have been content with the bare necessities, limiting the signals to door bells, buzzers and chimes. Very little consideration has been given to safeguarding children and other members of the family against the possibility of a fire occurring during the day and particularly at night. The installation of an automatic fire alarm system would produce the desired result at nominal cost. Likewise, a dependable burglar alarm system would protect the physical contents, and a photoelectric or electronic sound system would protect the nursery, children's and invalid rooms.

The type of systems used in residences may be divided into two groups. First, those providing protection and second those offering convenience. The systems used in protection are the automatic fire alarm, burglar alarms, safe alarm, tank alarm, door phone, nursery communication, watchman's tour. The systems used for the convenience of the owners and guests are door signals, room call, recreation room call, electric clocks, In and Out, intercommunicating telephones, paging, centralizing radio and sound.

An automatic fire alarm system should be installed throughout the building, particularly in the attic, basement, kitchen, master bedroom, children's bedroom and garage. In large properties and estates this protection should be extended to the help's quarters, barns, storage houses, silos etc. The protective units may be of the combination rate-of-rise and fixed temperature thermostats where normal temperature fluctuations exist. Units of the fixed temperature type may be used where unusually violent temperature fluctuations are prevalent. An example of the latter would be a room having a fireplace or a furnace. In general there are two types of these systems, the electrically wired type in which the thermostatic detectors are connected by means of conductors to a control panel or control annunciator, and the pneumatic type in which a small metallic tube is run in all areas and is terminated at detectors from which point the alarm is transmitted. Test buttons or other facilities should be provided on all systems. A siren may be added as an outdoor signal or a bell may very often be located in the local fire headquarters when the property is located a considerable distance from a town. An illustration of a typical thermostatic detector is shown in Fig. 1. An open circuit wiring diagram is shown in Fig. 2, while a closed circuit system is shown in Fig. 3.

Burglar alarm systems should be installed on all entrance doors and windows on the first and basement floors, and preferably at all possible points of entry within 15 feet of the ground. Entrance doors may be protected by means of contacts, however, glass panelled doors require additional protection such as foil stripping or wired screening over the glass panes. Windows may be protected by contacts with foil stripping on the window panes. Insect screens may be woven with small gauge enamelled wire for additional protection to windows when they are open. Closed-circuit systems are preferable and the most reliable. In small homes a single bell as a signal is usually considered satisfactory. In large homes or estates, annunciators may be used to indicate the section of a building or other specific buildings where an alarm has originated using bells at various locations. Lock switches may be used in door circuits to permit the occupants to enter the home without operating the alarm.

A door phone system is very essen-

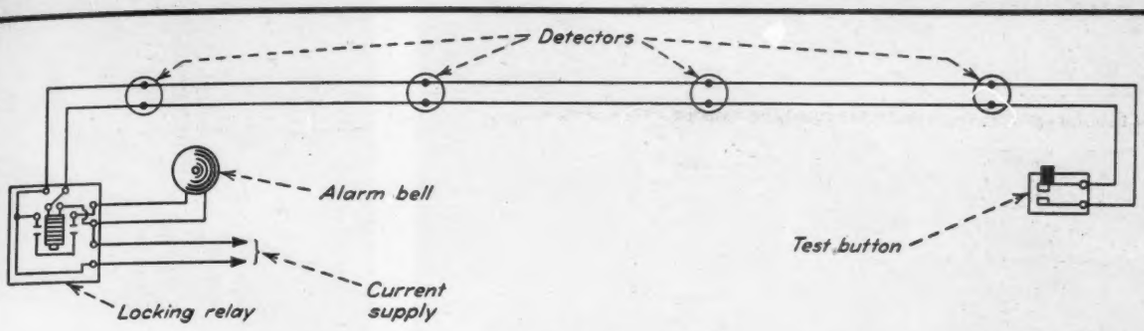


FIG. 2—OPEN CIRCUIT FIRE WARNING SYSTEM WITH LOCKING RELAY AND TEST BUTTON.

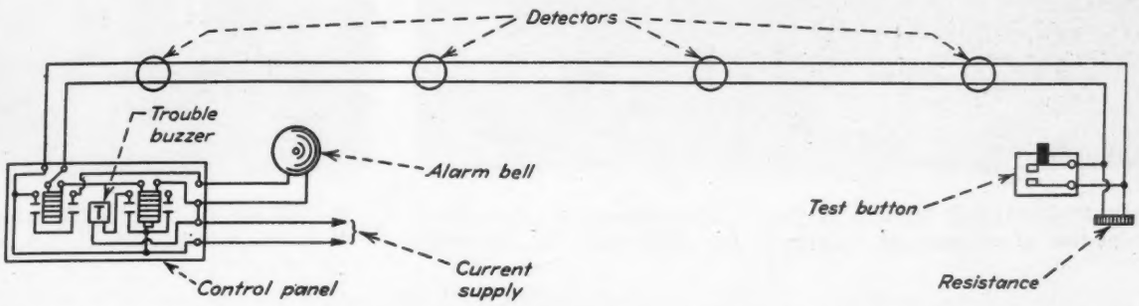


FIG. 3—CLOSED CIRCUIT FIRE WARNING SYSTEM PROVIDES ADDITIONAL WARNING OF SYSTEM TROUBLE.

tial in any home. Such a system is composed of a loudspeaking phone installed adjacent to the front door with either a cradle or wall phone in the kitchen and a wall phone in the basement. This enables conversations to be carried on with any person at the front door without exposing the occupant to the dangers of those with criminal intentions. Besides, it saves footsteps and avoids unpleasant experiences with peddlers, beggars etc.

Small safes if of the recessed type may be protected by means of door contacts attached to the safe or on the panelled door behind which the safe is installed. If a safe is of the floor type it may be enclosed in a protective cabinet composed of a network of conductors or foil. Connection may be made to a control panel and the alarm signal. The room containing the safe and other valuables may also be protected with photoelectric rays which will transmit an alarm when the light rays are interrupted.

Tank alarm systems are used in large properties remotely situated and consist chiefly of a tank float to indicate the high and low water levels, a control panel and an alarm bell to notify the attendant. The tank float may also be used to operate or stop the water pump used to fill the tank.

Nursery communication systems are of the electronic type consisting of loudspeaking units, one of which is installed in the nursery, the other in a designated bedroom or maid's room. This system enables the responsible person to listen in on activities in the nursery where they are of a personal nature or intrusion of unauthorized persons or criminals. A photoelectric system may also be used to protect the nursery from intruders and to send an alarm to any given point.

Watchman's tour systems are used on large estates and insure complete coverage by the guards. Watchman's stations may be located in the main residence, help's quarters, garage, barns, entrance to the property and remote points to cover every available location. The stations should be of the compulsory type assuring calls over the entire tour. Starting and finishing signals may be recorded at some centrally supervised location.

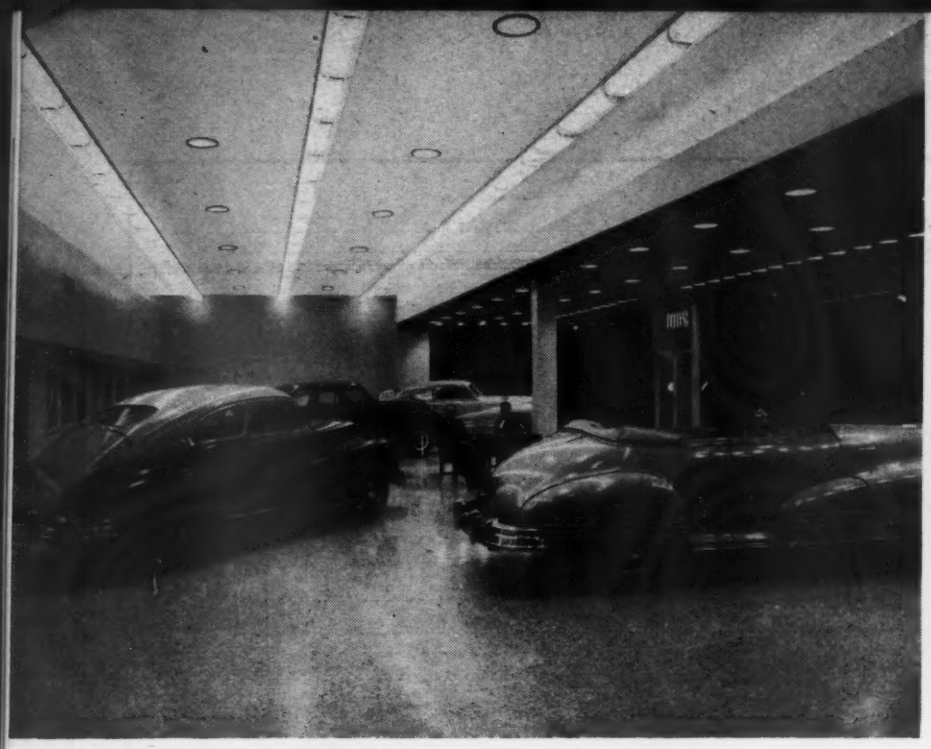
Door signals may be of several types. In low priced homes a bell is operated from the front door and a buzzer from the rear door. In medium priced homes a dual toned bar or tubular chime is used for both, the double signal or dual tone for the front door, and a single signal or single tone for the rear or service entrance. For the expensive home tubular chimes are used to designate the door signals and a dining room call. These are usually of the motor driven type which result in a combination of tones. In large estates a photoelectric ray may be used near the main entrance to indicate the approach of persons or vehicles. Extension signals for front and rear entrances are very serviceable and insure audibility.

Room calls are generally used in the large and expensive residences for calling guests and members of the household. These usually consist of return call button and buzzer stations located in bedrooms, library, porches, living rooms etc., and are connected to a return call annunciator located in the kitchen, pantry, maid's room or other convenient point.

Recreation rooms in the larger and expensive residences are provided with calling stations which are composed of a stationary pushbutton and a receptacle for the insertion of a portable plug cord and button. The stationary button is used for regular service while the portable button is attached to the receptacle for the use of those sitting at tables. All calls terminate at an annunciator located in the butler's room or pantry.

Electric clock systems are a very valuable contribution to a home. Generally, individual portable electric clocks are used in small homes. However, in the large and expensive home a centralized controlled clock system may be used. The master or control clock may be had in decorative forms such as grandfather's type with the

[Continued on page 96]



1a DIRECT-INDIRECT lighting provides quality illumination for critical inspection of all new car features in this Pittsburgh, Pa., showroom.

3 INDIRECT COVE LIGHTING is used in this Rochester, N. Y. showroom to

1b VIEW OF LIGHT finished walls, floor and ceiling through all-glass front provides bright background area to attract attention to cars on display.

Auto Salesroom Lighting Techniques

2 COMBINATION FLUORESCENT-INCANDESCENT recessed units installed in the ceiling provide maximum lighting flexibility in this Downtown Motors showroom in Buffalo, N. Y.

NEW automobiles are being put on display in showrooms all over America. Production is beginning to catch up with demand. When this finally occurs, salesmen will again adopt new selling techniques, and auto dealers will give more thought to modern display methods. Lighting is one of the most potent forces in modern display, when properly used. Dealers may therefore soon be expected to demand lighting tailored to their own specific display requirements.

Auto salesmen are developing a brand new automobile language these days, to help them point out the many new technical developments, econ-

provide diffused light. Incandescent reflectors provide attraction lighting.

4a RECESSED TROFFERS provide lines of light in this Beverly Hills, Calif., showroom, which accent body contours when reflected in the new cars. ↑

4b HORIZONTAL AND VERTICAL electric signs supplement the brightly lighted showroom in attracting attention of passing traffic. ↓

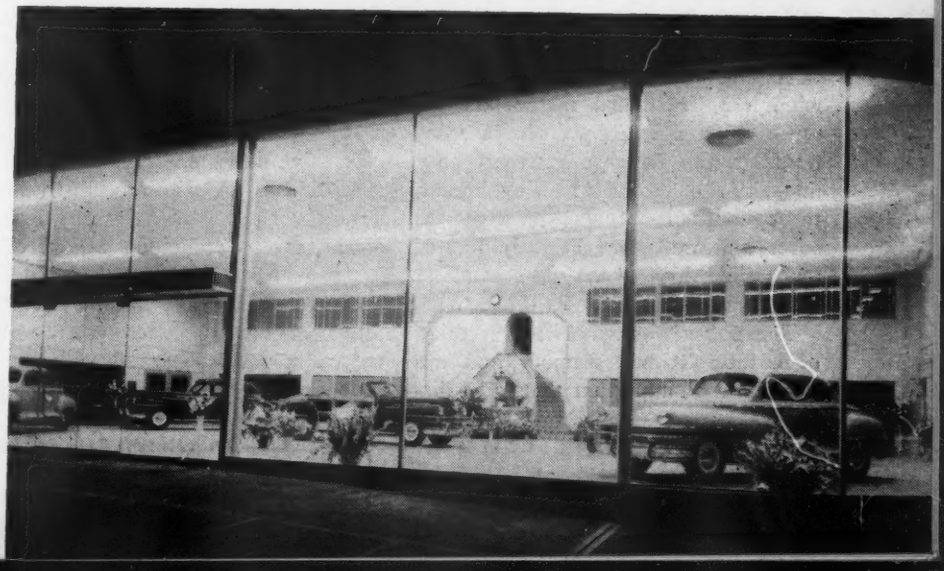
Analysis of postwar lighting in auto salesrooms indicates trend to fluorescent for diffused lighting and to incandescent for accent lighting.

By
Berlon C. Cooper

omies, safety and comfort features of the new cars. Lighting men are also developing a new language in lighting for automobile display. It includes lighting to attract and hold attention, lighting to create an inviting and harmonious atmosphere, and lighting to permit critical inspection and detailed appraisal.

Lighting for attraction is not new. Theaters have used it for many years. One function of show window lighting is also to attract attention. The modern postwar automobile salesroom is, in effect, a large show window. One or more sides of the showroom are usually all-glass fronts, permitting full

5 RECESSED FLUORESCENT lens troffers provide efficient general diffuse lighting in this Oklahoma City showroom, and incandescent recessed reflectors at window line add attraction lighting.



6 LUMINOUS LOUVERED CEILING in this Indianapolis showroom provides graduated intensity varying from 120 footcandles at window to 70 footcandles at rear wall simulating daylight conditions.

7 SUSPENDED LUMINOUS TROUGHS create an artificial sky in this Rochester, N. Y. auto salesroom. Recessed incandescent reflectors add punch lighting at window line and throughout.

view of the entire display area.

Three different lighting methods are used to attract attention to auto salesrooms. A familiar one is the use of illuminated signs (Photo 3) and large exterior luminous areas. A second method is the use of typical show window reflectors and spotlights, installed inside the plate glass front (Photos 1, 3) to provide a high intensity of light on the vertical surfaces of automobiles displayed close to the windows. The third method is the use of light finished walls on the interior of the showroom, and a high intensity of general illumination throughout (Photo 4a) so that the autos and walls are brightly lighted and visible through the glass fronts at considerable distance.

The postwar automobile is a thing of beauty. It has glamour and eye appeal. It is important that it be displayed in an atmosphere of beauty and glamour. Lighting is one of the decorator's best mediums for creating a harmonious atmosphere and setting for the modern automobile. Thus, light may be used as a decorative medium, to create an effect of warm sunlight, or an effect of cold winter scenes. Judicious selection of light sources for the general lighting system will often accomplish these and other similar effects. In other cases, decorative lighting in coves, wall niches, on murals, etc. can be used strictly as a decorative medium.

As will be noted in the illustrations, all showing postwar-lighted display rooms, several techniques are effective for providing utilitarian light for detailed inspection and appraisal of the autos on display. Each will be discussed in detail separately.

It is considered that the prospective customer can best inspect a new car, its long, low lines, body finish, interior upholstery, size, head and leg room, and under-the-hood construction, if the car is out-doors on a clear day, either in the shade or in direct sunlight. In such a setting, a high intensity of well diffused illumination results. If the car is in direct sunlight, sparkle is added to all bright metal trim, such as bumpers, door handles, radiator trim, and hardware. The diffused light from the entire sky provides ideal illumination for appraisal of color and body finish, without the annoyance of reflected highlights on the many curved surfaces. Duplication of the same quality of diffusion inside the salesroom should therefore provide the most ideal type of artificial lighting for display.

A high intensity of indirect lighting (photo 3) on the order of 40-50 footcandles provides illumination with a proper quality of diffusion, such as would obtain outdoors in the shade. Intensities higher than 50 footcandles from indirect lighting only would introduce a source of annoyance in an overly bright ceiling. Light finished walls and floors, as in Doyle's Main Motors, Inc. salesroom, Rochester, N. Y. (Photo 3) help prevent undue contrast between the brightly lighted ceiling and other areas of this display room. Incandescent reflectors inside the all-glass front, slanted at an angle to prevent daylight reflections in the glass, provides a highlight to attract attention to the salesroom and add some sparkle to polished bright metal trims on the cars. Note the absence of annoying reflected light on the body of the single auto on display.

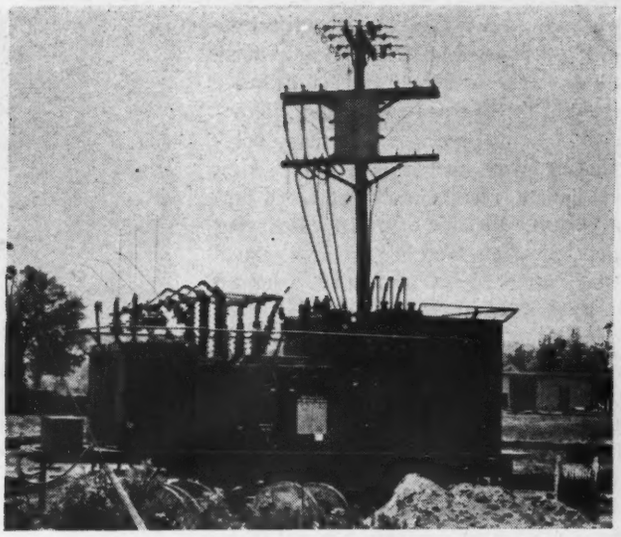
The Downtown Motors display room in Pittsburgh (Photo 1), uses cove lighting, supplemented by three continuous rows of fluorescent ceiling-mounted units. The fluorescent units have luminous sides, to help keep the ceiling evenly lighted, and louvered bottoms. Incandescent reflector units are recessed on symmetrical spacings over the entire ceiling, as well as on close spacings along the ceiling adjoining the all-glass front. The direct light from these incandescent units aid in improving the color quality of the resultant illumination throughout the display area, and add a desired sparkle to all bright metal trim on the cars.

In the Monarch Buick Company display room in Indianapolis (Photo 6), effective use has been made of a partially louvered ceiling, and of recessed

[Continued on Page 220]

Calvert Switches To Higher Capacity

Plant expansion and increased load, making original substation inadequate, is provided for by changeover to new and larger transformers.



MOBILE SUBSTATION of 1500 kva. capacity was used to provide electrical service during changeover to larger transformers at Calvert Distilling Company plant, Relay, Md.

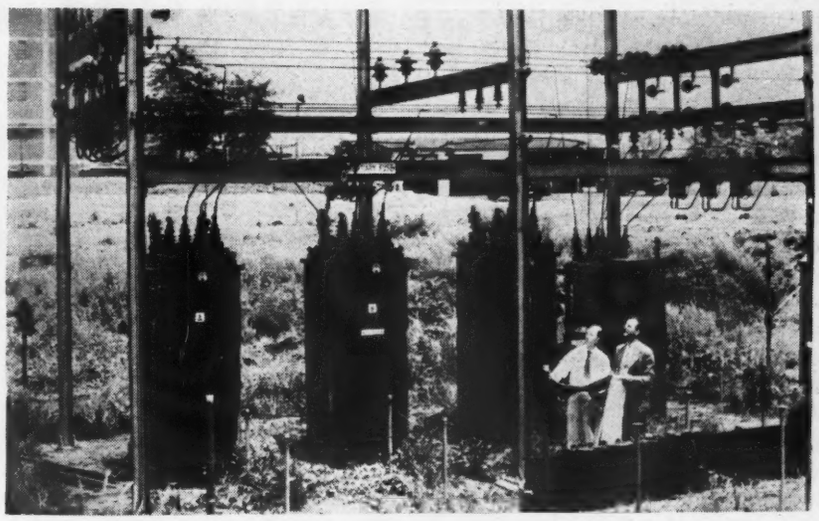
THE Relay, Maryland distillery of the Calvert Distilling Company is less than twelve years old. In that short period of time, however, the electrical load has exceeded the original substation kva. capacity by nearly one-third. This condition has been caused by plant expansion and by increased use of electrical equipment throughout the plant.

The original substation consisted of 3-500 kva. transformers, operating at 13,633 volts, 3-phase, 3-wire. At the beginning of the war, a total of five "load centers" had been installed, with a total transformer capacity of 2050 kva. Due to priority restrictions, the plant operated under these conditions throughout the war. Upon the removal of priority restrictions, Calvert contracted with the Eastern Electric Company of Baltimore for a new substation of 3000 kva. capacity. This new substation has been completed, and is now in operation with an approximate 50 percent reserve capacity.

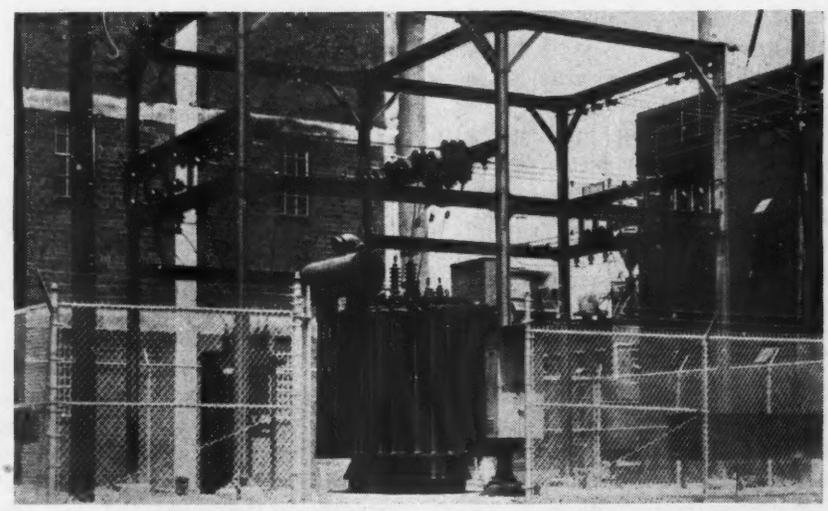
In making the changeover, Eastern Electric used a mobile substation, which was furnished by the local electric utility. This mobile unit was of 1500 kva. capacity. It was temporarily installed nearby during the changeover, and connected to furnish power to the plant without interruption.

The new substation consists of 3-1000 kva. transformers. Primary service is at 13,633 volts, 3-phase 3-wire. Secondary service to the five "load centers" is at 4160 volts, 3-phase, 4-wire.

Secondary service from "load centers" is primarily at 440 volts for power loads, and at 220/110 volts for small motor loads and lighting.



ORIGINAL SUBSTATION, with 3-500 kva. transformers is replaced by . . .



. . . NEW SUBSTATION, containing 3-1000 kva. transformers. Eastern Electric Co., Baltimore electrical contractors, made the changeover.

TEST METHODS

Obtaining accurate measurements of electrical consumption, demand, horsepower and power factor is possible with standard polyphase power meter.

By A. F. Stilson

INSTRUMENTS for properly testing 3-phase 3-wire motors are rarely available for use by the maintenance crew in the average small plant. However, by substituting an ordinary polyphase power meter for this lacking equipment, results can be obtained that are quite satisfactory. In discussing the following methods, it is assumed that balanced current and balanced voltage exist but, since these balanced conditions are generally found to exist in 3-phase motors, the assumption is justified. Data to be obtained by the discussed methods include the kilowatt-hour consumption, the kilowatt demand, horsepower in use, power factor and, in the absence of an ammeter, an approximation of the amperes pulled by the machine being tested.

Obtaining an old power meter for test purposes is not difficult for many utility companies have quantities of obsolete units which may be purchased quite reasonably. All that is necessary in addition to the power meter is a voltmeter. Available power meters, superseded by later models but still useful, include the early General Electric Type D-6, Westinghouse OA's and C's, and other similar units. These meters can be obtained in various capacities ranging from 5 amperes and 100 volts upwards, and purchase prices are often so reasonable that it is feasible to obtain several units of various sizes. When selecting a polyphase meter, it is important to verify the condition of the unit, making sure that both elements are intact, phases are balanced and adjusted accurately for both 100 and 50 percent power factor.

To obtain the kwh. consumption of a motor, merely connect the meter into the circuit (Fig. 1), take readings at the beginning and end of a measured period, and record the difference in these readings.

Obtaining the kw. or watt demand is possible through the application of a simple formula. Of course, the watthour constant of the meter (the value in watthours of a single revolution made by the meter disc) must be known, and this can usually be found stamped on the disc (as in the case of a D-6 meter), printed on a slip of paper located inside the terminal covers (as on an OA type), on the nameplate of later models, or can be obtained from the meter department of the local utility company. When found, the watthour constant can be reduced to watts:

$$\frac{\text{Watthours per revolution} \times 3600 \times \text{Revolutions of disc}}{\text{Time in seconds}} = \text{Watts}$$

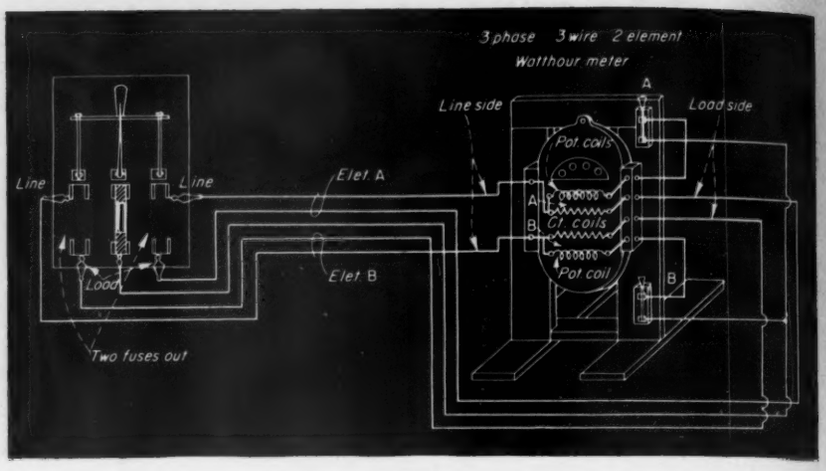


FIG. 1. Power meter is connected into circuit and mounted on wooden rack for maximum ease in positioning equipment for test purposes.

For example, a General Electric 25-amp. 220-volt 3-phase 3-wire polyphase meter has a watthour constant of 6. Assuming that the motor to which it is connected causes the discs to rotate 20 revolutions a minute, the demand is:

$$\frac{6 \times 3600 \times 20}{60} = 7200 \text{ watts, or } 7.2 \text{ kw.}$$

Dividing this result by 746 (watts per horsepower) shows a load on the motor of 9.7 hp.

When determining the power factor, the meter should be arranged so that potential or voltage coils of each element can be cut out one at a time. A meter mounted on a wooden rack and arranged as shown in Figure 1 is conveniently portable for this purpose. In testing, upper and lower discs should be timed separately. This is accomplished by opening one switch, timing the element remaining in operation for 10 revolutions, closing the first switch and opening the second, and timing the other element for an equal number of revolutions. It will be found that, with a power factor of unity, both discs will run at the same speed; if the power factor is other than unity, one disc will run slower than the other and, if the power factor is below 50 percent, one disc will run backwards.

In obtaining the power factor, the time taken by the faster or forward moving disc to make the given revolutions (S_f) is divided by the time taken by the slower forward or backward rotating disc to make the same number of revolutions (S_s) and the resultant is referred to either Table I or Table II. Table I is selected if the slow disc moves forward, while Table II is applicable only when the slow disc is running backwards.

For example, if one disc of the previously mentioned G. E. D-6 meter made 10 revolutions in 67 seconds and the other disc took 20 seconds for the same number of rotations, the proportion between the faster and slower elements would be:

$$\frac{S_f}{S_s} = \frac{20}{67} = .298$$

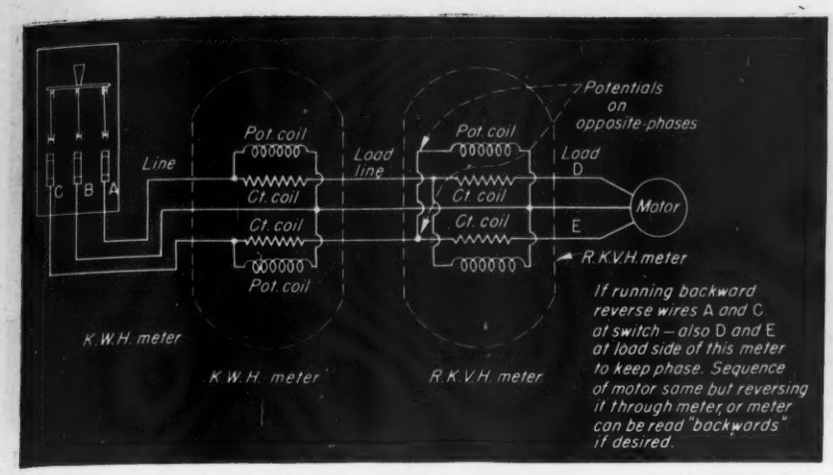

Potentials on opposite phases
Pot. coil
Line
Load line
Load
Ct. coil
Motor
R.K.V.H. meter
K.W.H. meter
R.K.V.H. meter
If running backward reverse wires A and C at switch — also D and E at load side of this meter to keep phase. Sequence of motor same but reversing it through meter, or meter can be read "backwards" if desired.

FIG. 2. Two polyphase meters, connected in series, may be used to obtain the average power factor during any selected test period.

for 3-PHASE MOTORS

Since both discs were running forward, Table I is referred to. It will be noted that 0.298 lies between 0.285 and 0.312, or between power factor 0.72 and 0.74. The motor, therefore, has a power factor of approximately 73 percent. If one of the elements had operated backwards, Table II would have been referred to and, since 0.298 would fall between 0.295 and 0.329, the power factor in that case would be between 28 and 30 percent. If the slow disc remained stationary or wavered uncertainly, the power factor would probably be around 50 percent. As motors running idle have power factors somewheres near this value, it is doubtful whether the slow disc would run backwards. It should be mentioned that either the upper or lower disc may be the faster or slower of the two, depending upon phase sequencing.

From the preceding data, a rough idea of amperes per phase can be calculated from the familiar formula:

$$I = \frac{\text{Watts}}{1.73 \times \text{volts} \times \text{power factor} \times \text{efficiency}}$$

Assuming an efficiency of around 80 percent and using a voltage value of 220, the previously mentioned motor would figure:

$$I = \frac{7200}{1.73 \times 220 \times 0.74 \times 0.80} = 32 \text{ amperes.}$$

This same method for checking kw. demand may be used on a single-phase motor by using one element only. It is obvious, however, that the power factor cannot be taken in this case although, by using the calculated watts from the meter and by using a voltmeter and ammeter, it can be easily estimated.

If it is desired to obtain the average power factor over a given length of time, two polyphase meters may be used, connected in series, with the voltage coils of one "cross phased" as shown in Figure 2. This second meter will then measure reactive volt-amperes. By multiplying the consumption as registered on this meter by 0.866, and dividing by the consumption of the kwh. meter, the tangent of angle of lag is found. Referring to trig tables will give the cosine or power factor.

Assuming that a kw. meter reads 30 kwh., and the rkva meter reads 29, then

$$\frac{29 \times 0.866}{30} = \frac{25}{30} = 0.83$$

Referring to Table III, it is found that the obtained value falls between 76 and 78 percent.

TABLE I

Si / Ss	Power Factor
.847	.99
.790	.98
.712	.96
.654	.94
.605	.92
.563	.90
.525	.88
.490	.86
.457	.84
.425	.82
.396	.80
.367	.78
.339	.76
.312	.74
.285	.72
.259	.70
.233	.68
.207	.66
.181	.64
.156	.62
.130	.60
.104	.58
.079	.56
.053	.54
.026	.52

TABLE II

Si / Ss	Power Factor
.013	.49
.027	.48
.054	.46
.082	.44
.110	.42
.139	.40
.169	.38
.199	.36
.230	.34
.262	.32
.295	.30
.329	.28
.364	.26
.400	.24
.438	.22
.478	.20
.519	.18
.562	.16
.606	.14
.654	.12
.703	.10

These two tables adapted from "Electrical Meterman's Handbook" Section 2, Page 19.

TABLE III

RKVA X .866 / KWH	P.F.	RKVA X .866 / KWH	P.F.
.194	.98	1.66	.52
.287	.96	1.73	.50
.364	.94	1.8	.48
.404	.92	1.96	.46
.488	.90	2.05	.44
.532	.88	2.14	.42
.601	.86	2.25	.40
.649	.84	2.48	.38
.700	.82	2.61	.36
.754	.80	2.75	.34
.810	.78	2.9	.32
.869	.76	3.27	.30
.900	.74	3.49	.28
.966	.72	3.73	.26
1.04	.70	4.01	.24
1.07	.68	4.33	.22
1.15	.66	4.7	.20
1.19	.64	5.67	.18
1.28	.62	6.31	.16
1.33	.60	7.12	.14
1.43	.58	8.14	.12
1.48	.56	9.51	.10
1.54	.54		

OLD LIGHTING was inadequate with eight footcandles intensity average, and spotty. Ceiling was dark and entire floor space could not be used.

NEW LIGHTING improved appearance of offices, provided 60 footcandles average, and permitted free arrangement of office furniture.

Relighting Improves Space Utilization

New *Planned Lighting* layout provides uniform intensity of 60 footcandles of shadowless illumination in offices of the Mutual Benefit Life Insurance Company of New Jersey.

USE of modern continuous-flow fluorescent lighting, installed in accordance with an engineered lighting plan, has made possible greater utilization of floor space in the general offices of the Mutual Benefit Life Insurance Company of New Jersey, Newark, N. J. Other benefits include elimination of shadows, uniform intensity throughout, an average of 60 footcandles, improved brightness ratios between the work and surrounding areas in the normal field of view, and improved appearance.

This new lighting installation replaced an old fluorescent installation made in 1939, in the early days of fluorescent lighting development. The old installation consisted of three 20-watt individual units which had been installed on the old outlet locations to replace incandescent units. The units were metal reflector direct lighting type fixtures, installed 11 feet 6 inches from the floor. The lighting result was inadequate light, with eight footcandles average, annoying shadows, dark ceilings and brightness contrast ratios in excess of the range recommended for seeing comfort.

The new *Planned Lighting* installation eliminates all the undesirable results of the old lighting system, and provides many new benefits. The new installation consists of 1790 Sylvania CL-440 luminaires installed in continuous rows on the second, third and fourth floors of the building. Each luminaire is equipped with four 40-watt 3500-degree white lamps, which are shielded from normal view by bottom louvers and diffusing side shields. Average illumination is 60 footcandles, with 56 minimum and 64 maximum, permitting floor space to be used from wall to wall. Fixture brightness is low, and ceiling is lighted softly. Objectionable shadows are practically eliminated. The appearance is excellent, which contributes to better employee morale.

UNDER OLD LIGHTING, seeing was difficult due to sharp shadows and annoying specular reflections.

WITH NEW LIGHTING, seeing was made comfortable by elimination of shadows and specular reflections.

New wiring was required for the lighting installation. All electric work was done by the Beach Electric Company, Newark, electrical contractors, who also replaced the existing panels with new breaker type panelboards.

Charles I. Brady, Jr., illuminating engineer for Sylvania Electric Products, Inc., made the lighting plan, working in conjunction with Harold C. Pennicke, management counsel of Greenwich, Conn., who was retained by Mutual Benefit to improve space utilization and increase efficiency.

BRIEF ARTICLES about practical methods of installation and maintaining electrical wiring and equipment and up-to-date estimating and office practices. Readers are invited to contribute items from their experience to this department. All articles used will be paid for.

Practical Methods

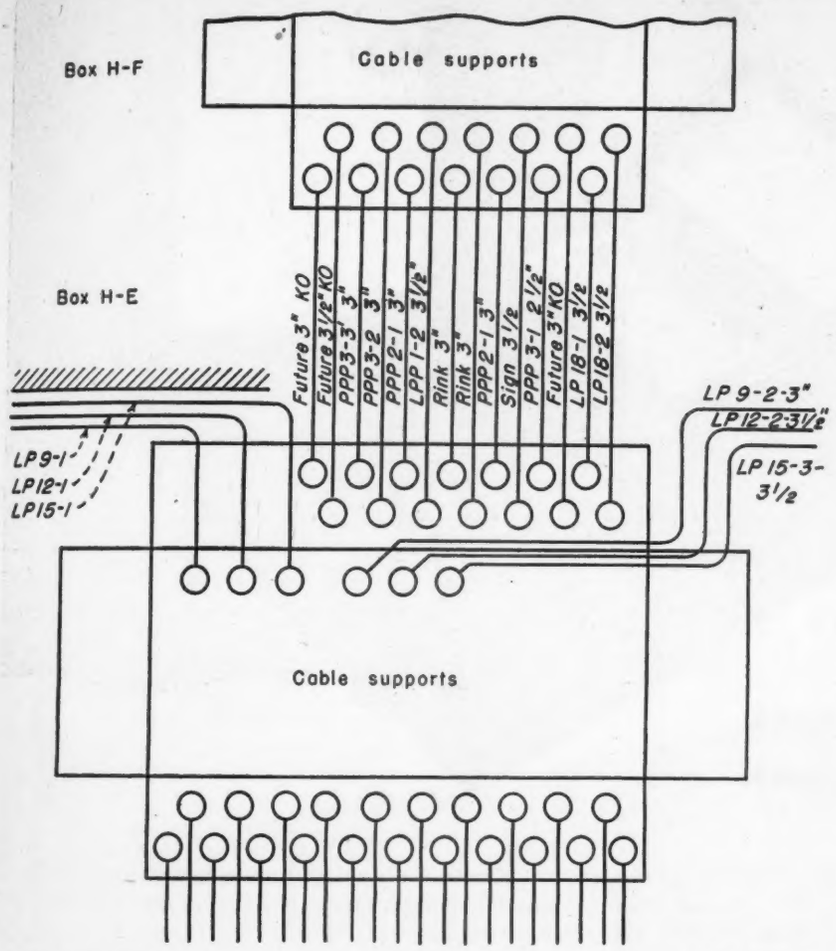


FIG. 1.—Portion of conduit riser diagram incorporates expanded-view pull box sketches; spots conduits; designates feeder cables by number, size and panel. Note shift from double to triple row of conduits in bottom pull box.

Multiple Conduits Spotted by Layout

ENGINEERING

A clear cut layout is welcomed by any mechanic on a construction job. It eliminates questions and delays. Everyone knows what is to be done when all details are down in black and white.

Long a proponent of detailed drawings, Arthur E. Bertke of Bertke Electric Company, Cincinnati, Ohio, insists upon detailed layout engineering on all projects his company handles. And this applies to every conduit group and pull box in the job. Some may feel this is going a bit overboard but Bertke finds it pays out in the long run.

Typical examples of his staff engineering were found on his most recent project, the Terrace Plaza Hotel Building in Cincinnati. Multiple feeder groups of 18 to 24 conduits (3-in. and larger) were not uncommon. Whether they were skirting columns, beams and ducts, or rising up a pipe shaft, the same detailed attention was paid to layout.

Pull, splice and cable support boxes were carefully designed to provide ample work space. Expanded-view sketches of each box, showing exact conduit spacing and location, were made for field use.

The same technique was applied to riser conduit layouts (see Fig. 1). Here the expanded-view pull box sketches were combined with the conduit riser diagram to give a clear-cut picture of the group of feeders all the way from the basement to the top floor. Each feeder in the group (in one case 25 3-in. and 3½-in. conduits) was tabbed with the following data: Conduit size, number and size of cables, panel designation.

When the 19-story conduit risers were installed, these layouts proved to be an ample guide. They were even more helpful to the cable-pulling crew since they eliminated possible crossovers in the numerous pull boxes.

Duct Tie Makes System More Flexible

WIRING

Electric power at the new Cambridge, Ohio plant of the Kingston-Conley Electric Company, Division of the Hoover Company, is distributed by six parallel 570-ft. runs of 400 ampere, 4 pole bus duct. Service is provided by two 600 kva, 3-phase, 4100/120/208-volt transformers located approximately 146 feet on each side of the center of the 570-ft. duct runs. Thus, each transformer feeds six 285-ft. duct lines.

Rather than tie the two 285-ft. duct runs together with a dummy section in which jumpers could be installed later if needed, management decided to look ahead of trouble and make a permanent connection when the system was installed.

So the Gustav Hirsch Organization, Inc., electrical contractors on the project installed a switch fuse adapter section in the center of each duct run. A duct section adjacent to each switch adapter is equipped with an expansion joint.

With the adapter section switch in the "off" position each 285-ft. run of duct is independently fed by one of the substations. Each substation then feeds one-half of the plant.

Should one of the transformers fail, any portion of its normal load could be

Rugged, accurate and direct-reading, the "Ducter" Low Resistance Ohmmeter provides an easy and practical way to test air and oil circuit breaker connections and contacts; cable joints; bus bar and line connections; armatures and series fields of generators, and motors; and low resistance transformer windings. It is also a valuable tool in quality control and for indicating relative strength and conductivity of welded joints.

One man can quickly make resistance measurements down to a millionth of an ohm—in the field! There are no calibrations or adjustments—not even for the voltage of the battery that supplies the necessary test current—and there are no calculations or charts. The resistance measurement is read directly from the position of the pointer on a scale.

The "Ducter" operates from an external battery or plug-in power supply. On every range it is compensated for outside temperature changes. As a protective feature a cut-out is included in the circuit to prevent application of too high voltage, and very high resistances or open circuits.

Various ranges of "Ducter" Ohmmeters are available to suit your requirements. A complete description, together with circuit diagrams, applications, and specifications are contained in Bulletin 24-25-EC. Write for your copy TODAY and learn all about this truly remarkable instrument.

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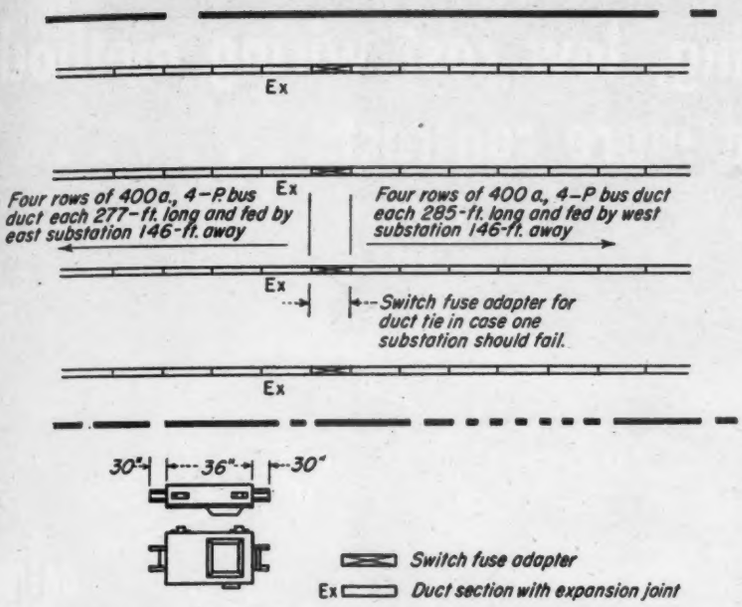
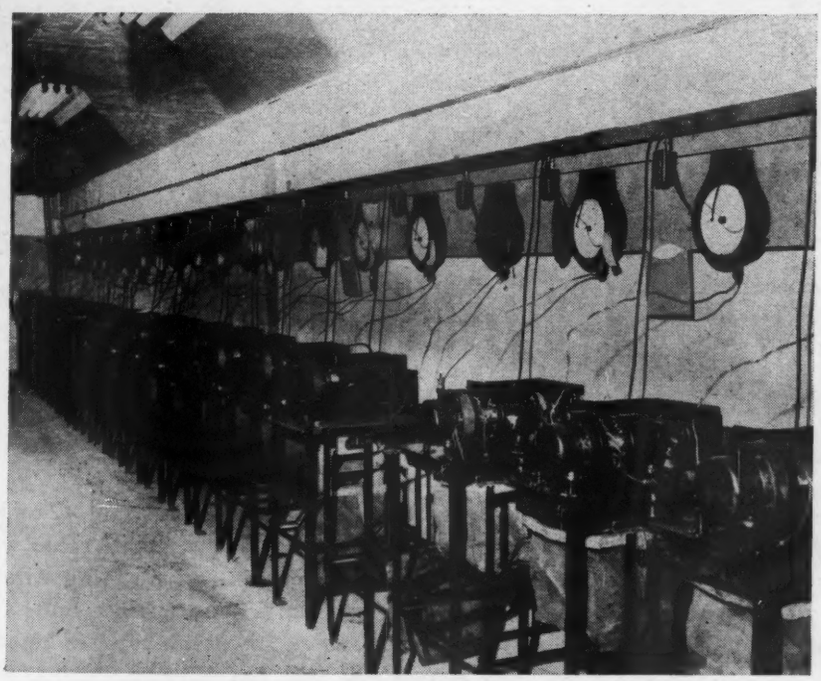

Ex
Four rows of 400 a., 4-P bus duct each 277-ft. long and fed by east substation 146-ft. away
Ex
Four rows of 400 a., 4-P bus duct each 285-ft. long and fed by west substation 146-ft. away
Ex
Switch fuse adapter for duct tie in case one substation should fail.
Ex
30"
36"
30"
Switch fuse adapter
Ex
Duct section with expansion joint

Diagram showing switch fuse adapter tie in bus duct lines. Load can be transferred from one transformer to the other by closing switch.

transferred to the second unit by merely closing the adapter switch tie. Depending upon demand and production requirements, one, two, three or possibly all six switches could be closed.

In the interim, repairs to the damaged unit could be made, or a replacement installed, without too serious a curtailment in plant output and with minimum inconvenience.



Surfaceduct distribution system, installed in two days by two men, consists of 66 outlets and 22 thermostat control switches for testing refrigerator units in Los Angeles appliance plant.

Surface Raceway Distribution

WIRING

The installation of a surface raceway wiring distribution system has simplified the testing of refrigerator units in the service department of a suburban Los Angeles appliance retailer. The completed job, including 66 outlets and 22 thermostat control switches, required two days' work by two electricians. Switches were mounted by means of ½-inch knock-outs in the bottom of the 2-piece steel raceway. The circuit, 120/240-volt single phase, is protected by a 70-amp. circuit-breaker. The single run of surfaceduct feeds 22 units consisting of electric clock-type pressure recorders, an Allen Bradley thermal control and the refrigerator unit being tested. A duplex outlet for each unit serves the refrigerator motor and the electric clock of the pressure recorder. The two single receptacles of each unit are wired in series so that a plug-type fuse may be inserted in one outlet to protect a pressure gage fed by the other receptacle. The installation of surfaceduct replaces a series of boxes and multiple conduit and the cost of the system was approximately one half of the former installation.

Industrial Precipitators

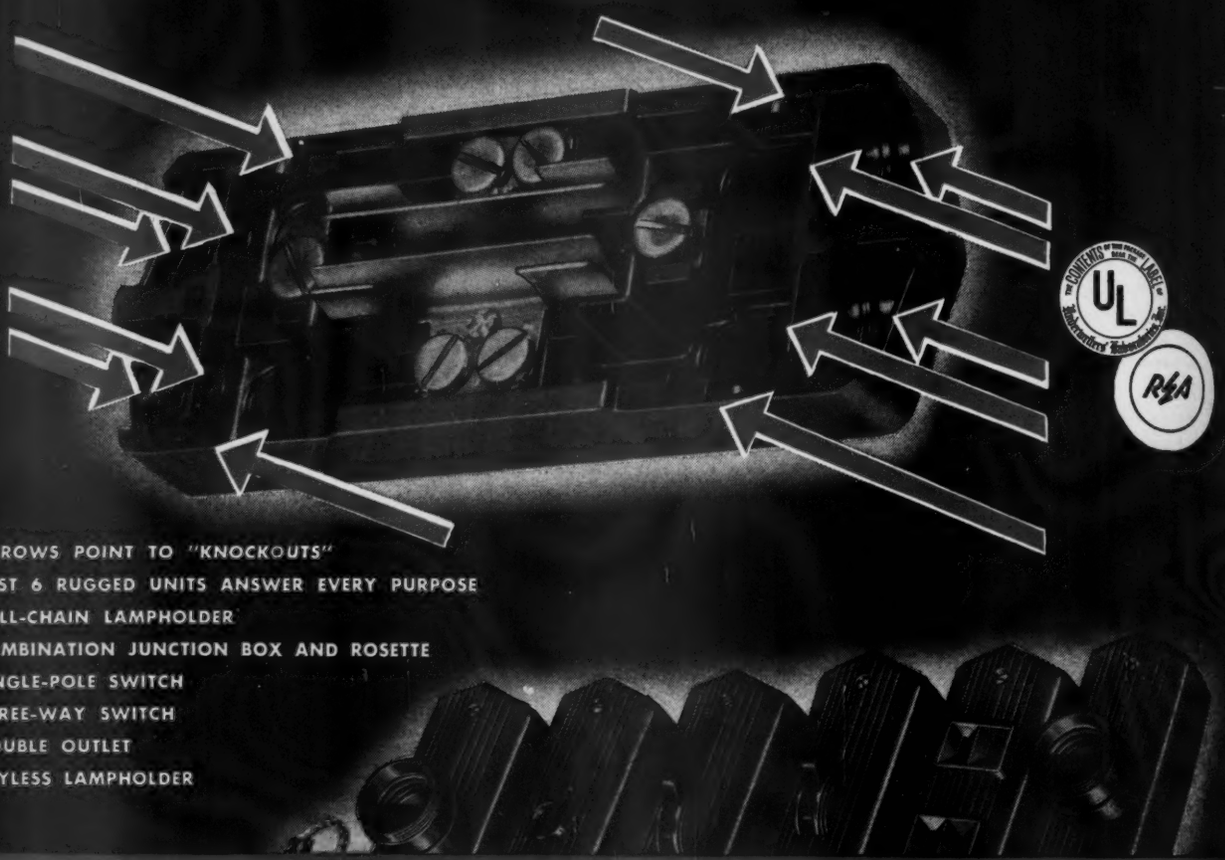
INDUSTRIAL

Removal or recovery of entrained solids and liquid particles from industrial gasses can be accomplished with efficiencies as high as 95 percent through the use of electrostatic precipitators. These efficiencies are around-the-clock measurements, including periods when material is discharged from electrodes and not merely ratings obtained during intervals of undisturbed precipitation. Regulated gas velocities and the length of time during which gasses and their entrainments are subjected to electrical high voltage discharge are taken into consideration in the design of units, insuring maximum recovery for sale or re-use, for refinement of gasses for more efficient use, or for nuisance abatement to meet municipal ordinances.

Specific requirements affect design and construction, for varying degrees of cleaning and the disposition of the precipitated particles are factors which cannot be ignored. A wide variety of precipitators cover the removal and recovery of tar oil and water from coke ovens, dry dusts from conveyors or grinding mills, soda ash from burning black liquor in sulfate processes and fly ash from boiler gasses.

Discussing the Koppers-Elex Electrostatic Precipitators manufactured in the Koppers Company's Baltimore plant, F. H. Linthicum, manager of the precipitator department, maintains that public consciousness has been turning for some time to the eradication of smoke from our industrial cities and smoke abatement ordinances have been passed in many major cities. Although permissible residual content

Use this amazing, low cost wiring method and land *more* contracts . . . . . .



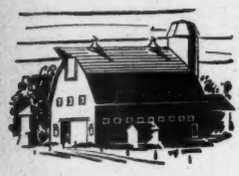
MONOWATT'S PLASTIC *SURFACE*

You'll pick up dozens of extra jobs with these Monowatt Surface Wiring Devices because you can run approved, dependable wiring *fast* and at *low cost.* Think how many new wiring jobs or extensions you can sell on this basis—farm buildings and warehouses; summer resorts and roadside stands.

Made of brown plastic, the devices are good-looking, tough, durable and light. They keep their color, resist moisture and corrosion and, unlike porcelain, do not easily chip or crack. Units triple as a box, switch or outlet and a plate. Plastic knockouts on ends and sides, as shown in the illustration, are easily removed with a screwdriver or pliers to make any device either "feed through" or "end run". The entire group meets REA and Federal Specifications and is listed by Underwriters' Laboratories for use with No. 12 or No. 14—2 or 3 conductor wire; non-metallic and armored cable with a special grounding clamp; also for building wire used with knob and tube work. Convenience outlets have double wipe contacts . . . switches are "T" rated . . . binding screws will take No. 12 wire.

By developing improvements in Surface Wiring Devices, Monowatt provides the answer to a country-wide demand for efficient, dependable, low-cost wiring. In the same way, Monowatt has pioneered improvements on a host of other wiring devices enabling faster installation . . . safer, better, more durable wiring . . . lower inventory requirements. Switch to Monowatt Wiring Devices and step up your margin of profit on any job!

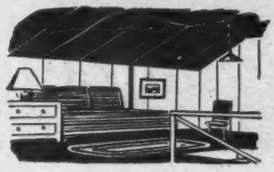
YOU HAVE HUNDREDS OF PROSPECTIVE NEW CUSTOMERS



FARM BUILDINGS

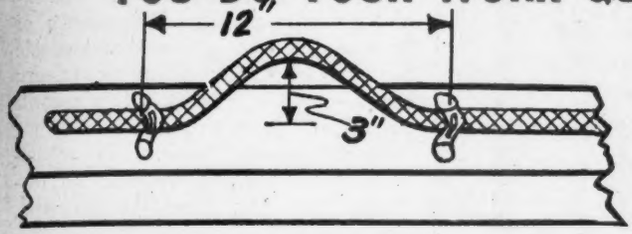
STORAGE SPACES
WAREHOUSES
STOCK ROOMS

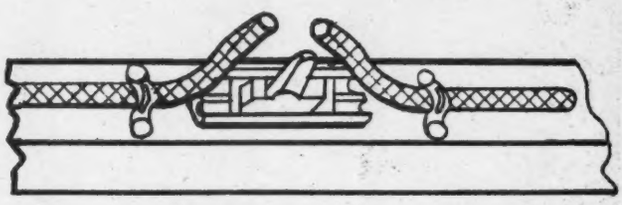
ROAD STANDS
CABINS
RESORTS



ATTICS
BASEMENTS
GARAGES

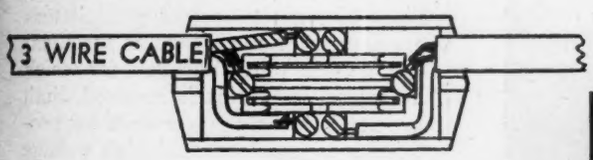
YOU DO YOUR WORK QUICKLY . . . . . EFFICIENTLY





1 **YOU RUN ALL YOUR CABLE FIRST** leaving a loop for each device you plan to install and wherever you think one may be required in the future.

2 **YOU QUICKLY CLIP EACH LOOP** and screw down the device. Here in a few minutes you accomplish what formerly took far longer because each unit triples as a box, switch or outlet and a plate.



DUPLEX RECEPTACLE

3 **YOU STRIP AND ATTACH WIRES** to large binding screws. Attach cover and move on. No soldering of splices or special connectors required. What could be easier?

WIRING DEVICES

WHY MONOWATT LEADS

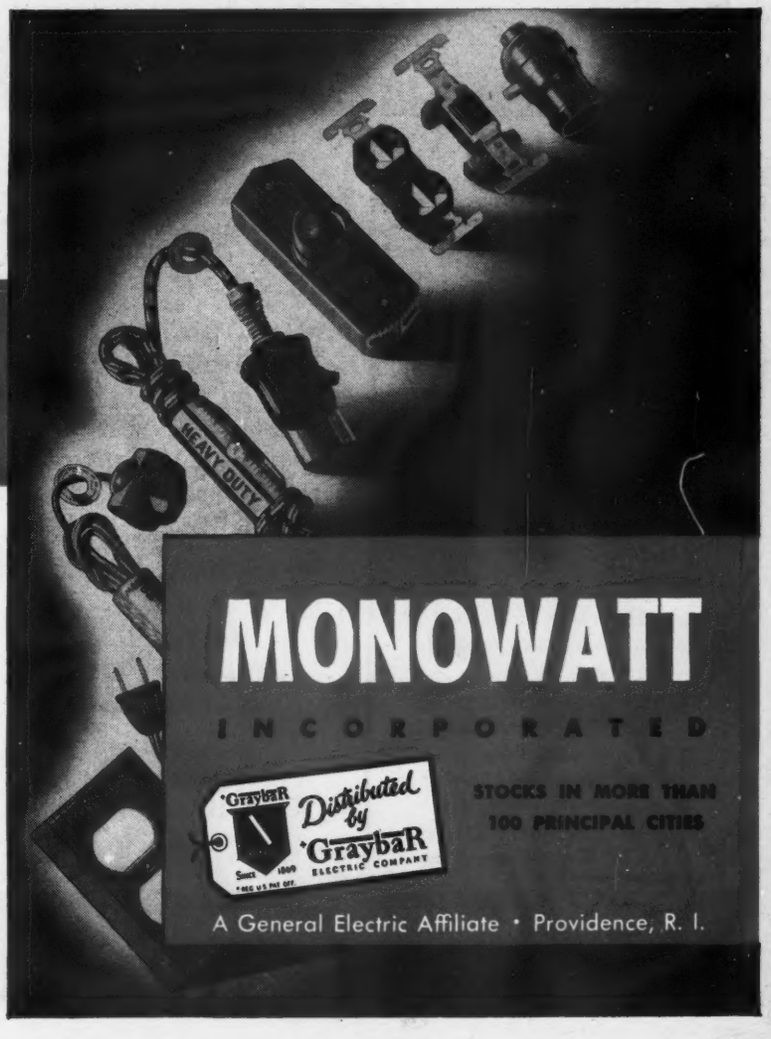
SIMPLIFICATION of many traditional wiring devices results in quicker, more efficient wiring . . . many products with multiple adaptations benefiting the user . . . a substantial cut in your inventory because a complete wiring job can be obtained from just a few basic Monowatt devices.

+ PRODUCT DEVELOPMENT. New, exclusive products have been created. Outmoded wiring devices have been replaced for safer, better, more durable electrical installations.

+ MANUFACTURING KNOW-HOW. Superior manufacturing methods at Monowatt are productive of better wiring for more people at lower costs.

+ QUALITY CONTROL. The Underwriters' Seal plus modern standards of quality processing insure long, trouble-free service from Monowatt products.

= GREATER VALUE



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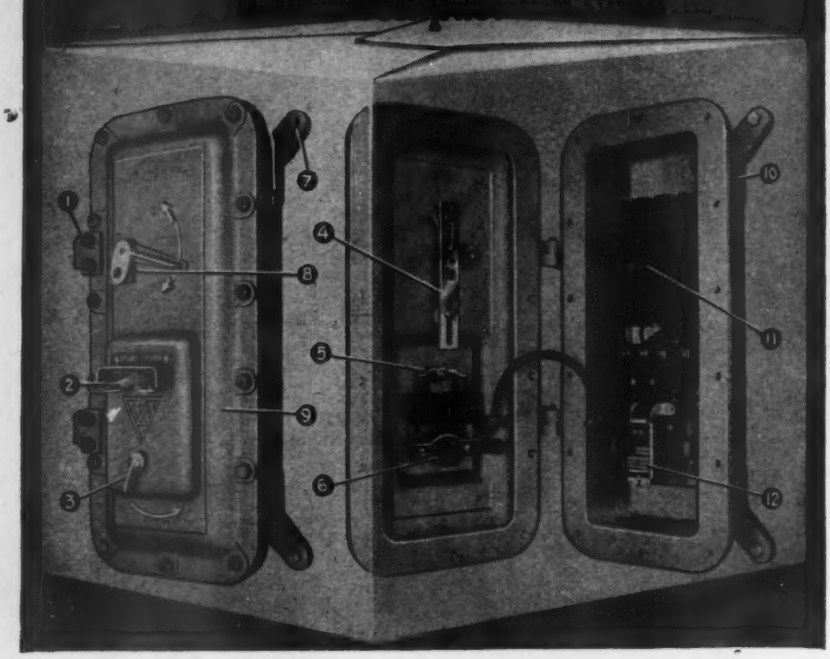

1 Hinges of Bronze . . . Unbreakable

2 Start-stop . . . Guarded No accidental Starting

3 Overload Manual Reset Lever Action

4 Slide Mechanism . . . Minimum wear on Breaker Handle

5 Push Button Lever . . . Rocker type

6 Overload Reset . . . Cam & Lever Action

7 Mounting Lugs . . . Extra Rugged

8 Can be padlocked in both ON or OFF positions . . . Breaker TRIP FREE

9 Corrosion-Resisting Finish

10 Close grain High Tensile Gray iron casting

11 Combination Thermal and Magnetic Breaker . . . Max. 100 Amp.

12 A.C. Magnetic Starter . . . Line Voltage Type

Designed to meet all Underwriters' Requirements For Class I Group D installations.

ALL ACTUATING SHAFTS ROTATE THROUGH OILITE BEARINGS . . . WILL NOT FREEZE

OTHER COMBINATIONS AND Ratings can be furnished

Installation costs at a minimum

Over Four Decades of Experience Designing Electrical Specialties

Representatives in all Principal Cities

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Precision-Built Electrical Equipment
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under these ordinances vary from 0.25 to 0.75 grains per cubic foot, many corporations realize that these limitations are excessively liberal and, to insure themselves against possible court action, they are specifying maximums of 0.15 grains. Only with electrostatic precipitation are these standards possible. Typical test results, obtained with Koppers-Elex Precipitators indicate that these standards are well within the range of accomplishment. A southern pulp and paper mill has a soda ash recovery of approximately 15 tons a day; with a salvage value of $30 per ton. An east coast gypsum recovery installation in connection with calcining kettles showed efficiencies of 99.8 percent. Efficiencies of 99.2 percent were achieved and salable tar was recovered from an eastern manufactured gas plant. Other records are equally promising.

Solid particle removal is accomplished by periodic rapping to discharge the dust from the collecting electrodes in a single gas lane at a time, with the dust required to fall a maximum of 26 inches before passing out of the gas stream. Rapping is actuated by clock-timer controls. Two types of electrical power precipitators are available; one known as the Elex-Pak and the other Vac-Pak, for which no special substation is required. Both are new packaged power units for production of unidirectional high voltage current.

Reference File For Auto Trunk

SALES AND ENGINEERING

The application of practical methods renders two types of service to the organization or individual advocating them. First: It improves the efficiency of performance, saving time and effort and reducing errors. Second: It impresses others, inspiring confidence and promoting additional business. This is particularly true when practical ideas are put to use by personnel coming in contact daily with potential customers for the method can also serve as a conversational springboard.

An idea which has prompted numerous favorable comments from customers and which aids sales is a portable catalog file in the luggage compartment of the car driven by sales engineer A. J. Shimer who works from the Allentown, Pa., office of the H. N. Crowder Jr. Company. Constructed of plywood, the file case contains compartments for two dozen large catalogs and numerous reference sheets, estimate pads and other data helpful to the engineer. In its compact form, the case

Direct to the men who make industry's decisions

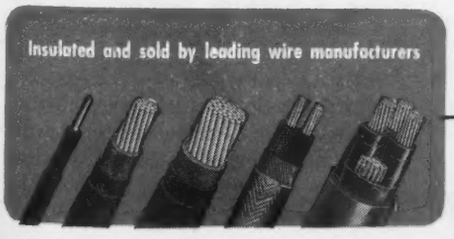
They've learned about it from the pages of The Saturday Evening Post, the Wall Street Journal, and their favorite business and trade magazines, where a full schedule of Alcoa advertising covers the whole range of industry.

And Alcoa advertising by mail is telling them, too. Thousands of architects, engineers, and other keymen have received attention-getting mailings enclosing an actual rubber stamp bearing the "*Figure It in Aluminum*" message. Full-color booklets, reprinting Alcoa E.C.* Aluminum advertising, have gone to important men in the electrical supply business. Three other fact-packed, illustrated booklets are on their way now to men who make industry's decisions.

Alcoa makes light, strong, conductive E.C. Aluminum, which leading wire and cable manufacturers fabricate into insulated wire and cable. They have it now. ALUMINUM COMPANY OF AMERICA, 2197 Gulf Building, Pittsburgh 19, Pennsylvania.

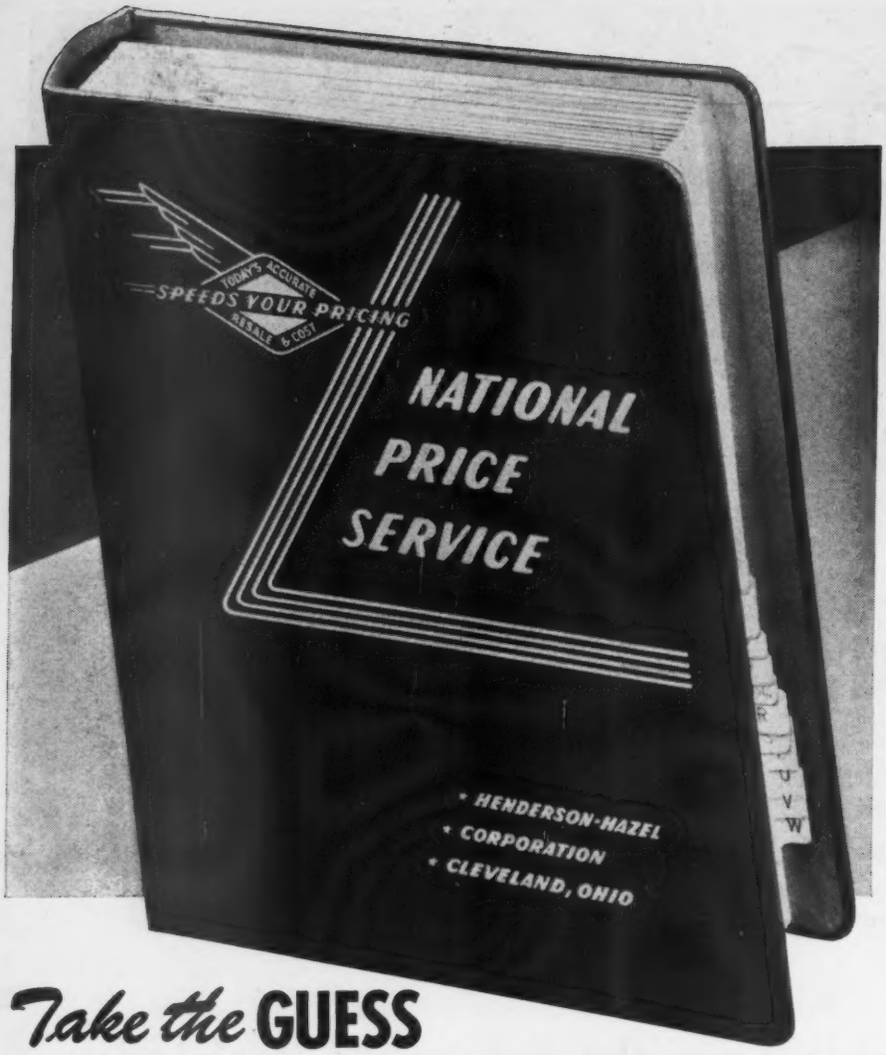
*E. C.: *Electrical Conductor* Aluminum

The BIG DIFFERENCE is in your COSTS!



ALCOA EC ALUMINUM

FOR ELECTRIC WIRE AND CABLE



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ELECTRICAL CONTRACTORS AND WHOLESALERS

Write for full information

HENDERSON-HAZEL CORPORATION
5005 EUCLID AVENUE • CLEVELAND 3, OHIO

A. J. Shimer, sales engineer for the H. N. Crowder Jr. Company of Allentown and Easton, Pennsylvania, employs a portable plywood file cabinet in the luggage compartment of his car for storing catalogs, plans, estimate pads and other reference material useful in preparing on-the-spot layouts or quotations for customers.

leaves ample space in the trunk of the car for spare tire, tools, luggage and demonstration equipment.

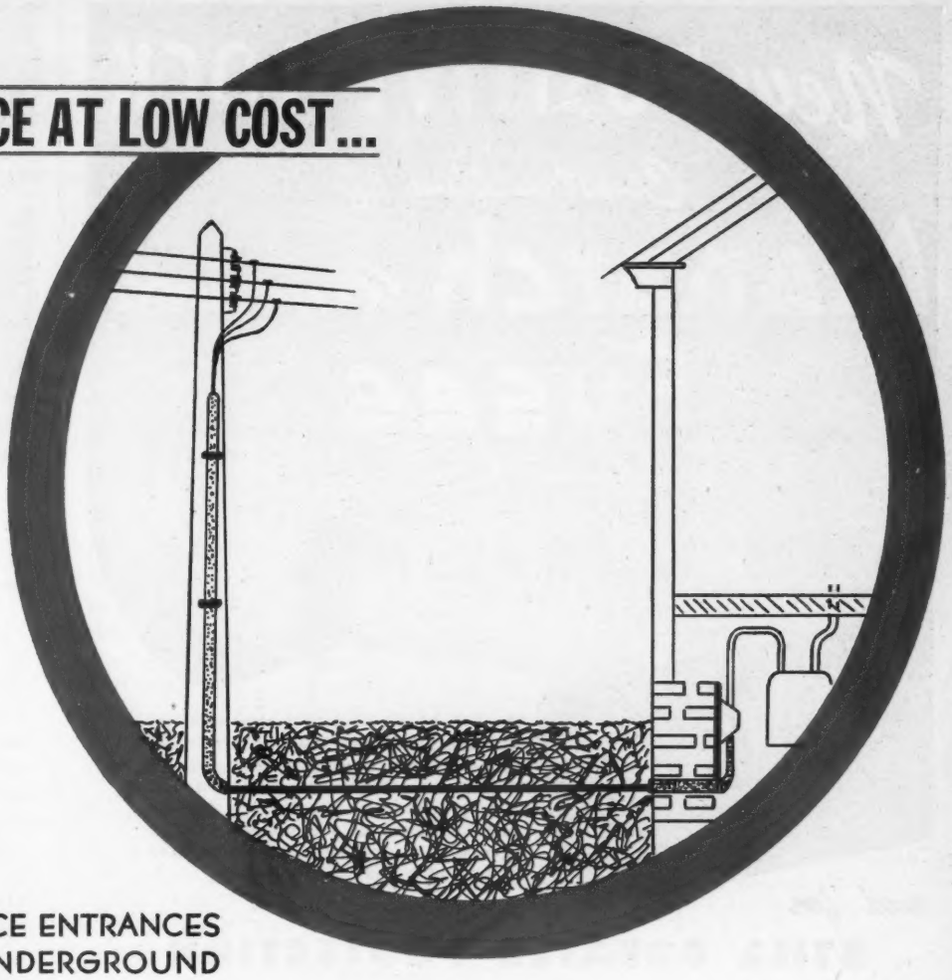
Lighting sales are also aided by utilizing the file compartments for plans and layouts, and storing various types of lighting fixtures in the compartment surrounding the file case. Since the file cabinet is designed so that the shelves are inclined away from the open end, the vibrations of the car do not cause catalogs or other material to slip out and become scattered. Also, since the entire file is light-weight plywood, the case can be lifted out of the trunk if desired, making room for other equipment. A portable desk is still another advantage for, with the file case placed on the ground, the engineer can sit on the bumper and use the top of the case for a writing or drawing surface. In filing material, several systems are practical, for data can be filed according to manufacturer, class of product or name of either the job or customer.

Floodlight Tower Supports Service

INDUSTRIAL

When designing the lighting and power distribution plan for the new Air Reduction Sales laboratories in New Providence, N. J., the Wigton-Abbott Corporation, engineering-contractors, developed their plans to conform with the semi-residential nature of the neighborhood. Smart, modern buildings look more like schools than industrial plants, and sweeping drive-

SERVICE ENTRANCE AT LOW COST...



FOR DEPENDABLE SERVICE ENTRANCES - AT LOW COST - GO UNDERGROUND WITH SIMPLEX-ANHYDREX CABLES

Simplex-ANHYDREX Cables meet Underwriters' specifications for Type USE, Underground Service Entrance Cables. But more than that, they meet the modern demand for concealed entrances at low cost.

Here are cables that have no outer braids, lead sheaths, or metallic tapes to boost buying cost. They can be buried in earth without additional protection, and their light weight and smooth jacket provide the easy handling and terminating that keep installation costs low.

Here too, are cables that assure uninterrupted service and long life. Their ANHYDREX insulation is unexcelled for electrical and physical stability in wet locations. Their tough neoprene jackets are not subject to electrolysis nor crystallization and they'll withstand exposure to soil acids and alkalies.

Simplex-ANHYDREX Cables eliminate the need for overhead wires which are exposed to weather hazards and which detract from civic beauty. They may be run direct from pole to meter or switch, and from the meter to other buildings. When used above ground they should be in conduit at least 8 feet from the surface. They should also be in conduit when within buildings.

ANHYDREX Cables are "years-ahead" cables, adaptable to long range farm, industrial, and residential planning. For assistance with your plans, write us direct or call in the Simplex representative nearest you.

Simplex

WIRES & CABLES

SIMPLEX WIRE & CABLE CO., 79 SIDNEY ST., CAMBRIDGE 39, MASS.

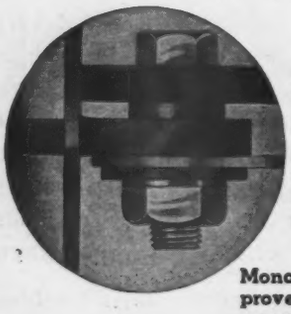
New POSITIVE LOCK Construction of Monarch Renewable Fuses

Assures → TRUE ALIGNMENT

The brass lugs inside the caps used on Monarch Fuses (see illustration at right above) fit into equally spaced slots in the brass casing inserts. This new and improved Monarch construction assures true alignment of the copper holding terminals . . . and establishes a positive lock on both ends of the fuse.

and for

STILL GREATER PROTECTION . . .



MONARCH'S Compressed Tension Lock Washer construction (illustrated at left) compensates for contraction and expansion of the fibre bar by exerting constant tension on the bar . . . and assures no loose parts. The washer also separates the fibre bar from the copper terminals . . . a spacer to provide better cooling.

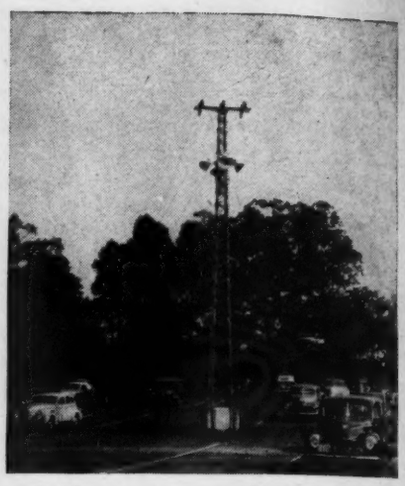
Monarch Fuses are fully approved and are available through recognized wholesalers.

Specify Monarch Fuses *for improved* FUSErvice

Monarch RENEWABLE Fuses

MONARCH FUSE CO., LTD.

118 E. FIRST ST., JAMESTOWN, N. Y.



Steel tower, centrally located in parking lot of Air Reduction Research Center, serves double purpose of floodlight tower and primary service support.

ways and landscaped grounds create an informality which blends with the surrounding residences. Driveway and loading platform lighting fixtures are incorporated into ornamental pedestals, and inter-structure distribution is predominantly underground, the single exception being in the parking area.

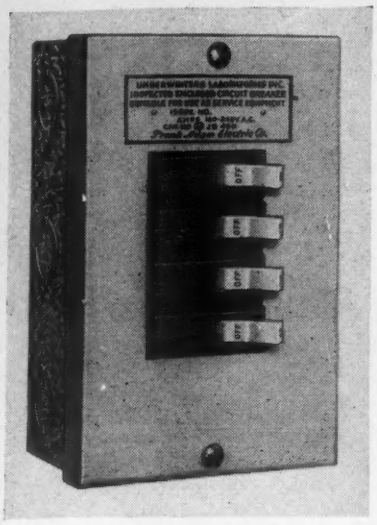
Here, inasmuch as high-mount floodlights were desired for parking convenience, a single steel tower was erected to serve the two-fold purpose of floodlight support and utility service carrier.

The 43-foot tower, centrally located in the 2-acre parking space, carries primary current at 13,200-volts, 3-phase, 60 cycles on a single crossarm. Current is progressively stepped down to 480- and 208/120-volts in both outside and inside substations for plant-wide motor and lighting utilization, and lighting feeders for the parking-area floodlights are run underground in 1½-inch conduit back to the base of the tower and up to four 750-watt floodlighting units. Lighting feeders consist of five number 8 RW cables, controlled from an interior lighting panel located in the adjacent main laboratory structure.

Floodlights are open-type widespread units designed for diffuse illumination, and incorporate porcelain-enameled steel reflectors with inner auxiliary reflectors of Alzak oxidized aluminum for maximum efficiency and control. Units are designed for minimum glare and all exposed metal fittings are plated to resist corrosion.

Each floodlight is supported by a Benjamin "Saflox" lowering attachment, consisting of a sheave housing installed 35 feet above ground, complete with terminal block and pulley; a floodlight hood suspended from the chain; and a chain anchor lever, attached near the bottom of the pole to lock the floodlight in place.

Equipment News



Circuit Breaker

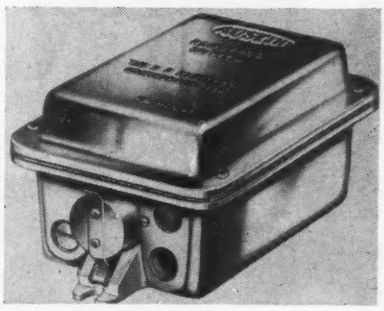
A new enclosed branch circuit breaker in a minimum size enclosure has been announced. Units are fabricated with Type a-c junior circuit breakers, and are built to Underwriters Laboratories standards. Available for flush and surface mounting, they have ample wiring space and conveniently located knockouts. Breaks are mounted with independent screws to facilitate removal or capacity changes of breakers. Entire breaker assembly and mounting bracket may be removed to simplify wiring. Units are recommended for controlling lighting in garages, residences, business houses, or for controlling small motors on machinery, of which the motor is a part. Frank Adam Electric Company, 3650 Windsor Place, St. Louis, Mo.

Runway Light

A new type BHI, bidirectional, high-intensity runway light has been announced for new installations or for replacement for existing lower-intensity runway lights. Units can be installed as direct replacements of old style high-intensity lights or can replace existing semiflush contact lights. BHI unit mounts on same base as older units. Two main beams are formed by duplicate double-lens assemblies from a single lamp. Color is provided by inner lens so that there are not hot colored lenses exposed to rain or snow. Controlled, uniform fill-in light across runway and on side away from runway is provided from same lamp by prismatic panels on side of unit. It uses a 200 watt, 6.6 amp. aviation lamp No. 6.6., A/T 14P with medium prefocus base. Westinghouse Electric Corporation, Pittsburgh 30, Pa.

Centrifugal Fan

A new line of small centrifugal type fans, Type 5CB, with a wheel diameter of five inches provides a wide selection of capacities for all type of cooling and ventilating needs. Units may be produced in single or double width types. They can be supplied with a wide range of motor sizes; motor size and speed being determined by the air required and the application. Brackets and mountings can be supplied. Size is suitable for cooling of electrical and electronic equipment. Inlet filters can be supplied to "pressurize" equipment cabinets with dust free air. Johnson Fan & Blower Corp., 1319 W. Lake Street, Chicago 7, Ill.



Control Switch

A new remote control switch for the operation of yard lights, machines, pumps, motors has been introduced. Known as "Remotrol" it is designed for use with any desired number of momentary contact switches. It is built for indoor or outdoor use. Unit consists of a solenoid plunger-type ratchet switch which is energized by operating a momentary contact switch. Circuit remains on, even though circuit is not energized until one of the momentary contact switches is again operated. Having once more become energized, solenoid moves the ratchet and breaks the circuit. Unit carries a replaceable 15 amp. Fustat protected by a spring-hinged cover. M. B. Austin Co., Northbrook, Ill.

Magnetic Starter

Bulletin 4111 size 1 a-c magnetic starters for non-reversing, across-the-line starting of polyphase squirrel cage induction motors and single phase motors have been developed. Starters are available with open type construction or with NEMA Type 1 general purpose enclosures. They are suitable for use with separate pilot devices for two or three wire remote control, or can be supplied with local control push-button stations or selector switches. They have a maximum enclosed rating of 7½ hp., 440-550 volts, three phase, 60 cycles. Standard operating coils can be furnished for 110, 208-220, 440 and 550 volt; 25, 50 or 60 cycle service. Dual voltage coils can be supplied for 110/220 or 220/440 volt, 60 cycles. Ward Leonard Electric Co., Mount Vernon, N. Y.

Expanding Anchor

A new expanding type, cone-slant anchor has been announced. It features three long, cone-slanted blades that extend into undisturbed earth to provide maximum holding power. A 3, 4 or 6 inch hole is dug with auger to desired depth. A strand of light wire is placed around blades to hold them in place. The anchor, with rod attached, is then dropped to bottom of the hole. A few blows with a spud or installing tool on the large anchor top breaks the light wire and expands the blades. The blades advance outward and upward to full length in the earth. Albion Malleable Iron Company, Albion, Mich.

midwest

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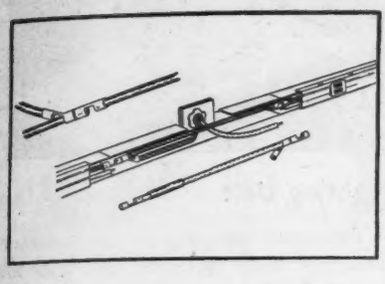


Plug-In Strip

This new plug-in strip provides a spread of evenly spaced electrical receptacles when there is a need for more adequate and convenient electrical outlets in stores, schools, laboratories, assembly benches, display windows, counter displays and offices. It is available in two lengths and two spacings of receptacles. Six foot lengths have outlets either 6 in. or 18 in. apart. Three foot length has outlets spaced every 6 in. Two No. 12 AWG copper conductors have been factory-wired into the channel which has a permanently locked-on capping. When full lengths, or parts of lengths, are joined in an installation, a copper barrel connector is crimped over the conductor ends. Strip can be cut to fit on job with a hacksaw, without taking assembly apart. It can be mounted either flush with, or on top surface of, moldings, tables or counters. It carries Underwriters' Laboratories approval. National Electric Products Corporation, Chamber of Commerce Building, Pittsburgh 19, Pa.

Reflector Lamps

These new 150 watt R-40 reflector flood and spot lamps have been developed for use in bullet shaped holders and recessed fixtures. They have a medium skirted mechanical base that cannot come loose, drop out or sag. Overall length of lamp is approximately that of cemented base lamps so they fit same fixtures with no change in light distribution, appearance or operating temperature of the fixture. Champion Lamp Works, Lynn, Mass.

Fluorescent Fixture

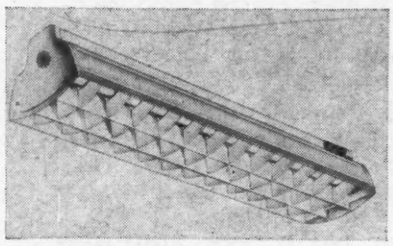
A four lamp fluorescent luminaire type CD-160 for schools and offices has been announced. It is available for suspension mounting as a direct-indirect type with steel louvered bottom or as a semi-indirect type with translucent plastic bottom of polystrene extrusion. A semi-direct distribution can be obtained by mounting the unit with louver bottom on ceiling brackets. Single and twin-stem hangers are available for suspension mounting or louvered units can be mounted on ceiling brackets when required. Starters are accessible without removing lamps. Ballasts are accessible after unit is installed by removing two screws at ends of channel. Westinghouse Electric Corporation, Pittsburgh 30, Pa.

Adjustable Climber

This adjustable climber has U-channel shank design providing greater strength with less weight. A removable gaff makes it almost impossible to cut out on a pole. Gaff can be replaced on the job by operation of special locking key. It has greater foot surface and improved eye for attaching climber straps. A new screw fastened adjustable shank allowing size ranges from 14½ to 17½ inches. Miller Equipment Company, Inc., Franklin, Pa.

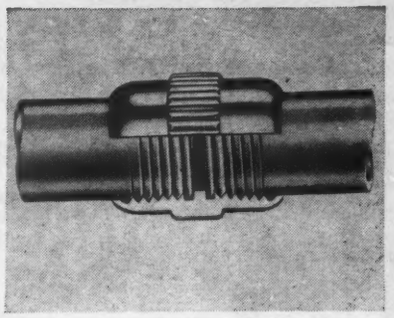
Raceway

Plugmold Jr. is a 30 inch metal raceway complete with three standard receptacles, and 6 foot cord and plug. Prewired, ready for plugging into an existing outlet, unit is easily attached to surface by means of two wood screws. It provides additional electrical outlets for present and future needs. The Wiremold Company, Hartford 10, Conn.



Lighting Fixture

This all purpose SM-440 luminaire is for hospitals, schools, stores, libraries, institutions and offices. Light diffusion upward is 40 percent indirect and 60 percent downward (direct). It is an all metal fixture affording 35° and 25° shielding with metal louvers. Other shielding angles are available. Louvers swing down or can be removed entirely. Available on special order are Alzac reflectors and louvers. Starters are externally mounted. Leader Electric Company, 3500 N. Kedzie Ave., Chicago 18, Ill.



Conduit Fittings

A new self-threading fitting line for E.M.T. thin wall conduit has been announced. These one piece, cadmium finished, steel fittings have a tapered thread that acts as a die, cutting its own threads on the tubing when screwed into locking position. They have been approved by Underwriters' Laboratories as raintight and are furnished with coarse knurled grips, but may also be obtained with hex grips if preferred. Briegel Method Tool Company, Galva, Ill.

Mercury Relay

A new mercury relay carrying current loads up to 35 amperes has been announced. It incorporates a free floating magnetic plunger. Heavy tungsten contacts with mercury to mercury make and break are hermetically sealed for dust and moisture proof operation. There is no exposed arc. Coil and load terminals are accessible on all installations. It operates on ½ wave unfiltered current. Overall dimensions are height 4 inches, width 2⅝ inches, depth 2¼ inches. It is available in two and three pole units. It is listed under Re-examination service of Underwriters' Laboratories, Inc. Ebert Engineering & Mfg. Co., 185-09 Jamaica Avenue, Hollis, Long Island, N. Y.

Fluorescent Fixture

The all steel "Turret" industrial fluorescent lighting fixture, model TR2-40, has been announced. The "Turret" lampholder device fixes the two 40 watt lamps in a rigid position. They cannot fall out, regardless of vibration. The new Air Loc fastener assures easy access to housing for maintenance. It operates on 110-125 volts, 60 cycle, a-c. Also obtainable with instant start or other voltages. Dimensions are 49-3/16 in. long, 13 in. wide, 7 in. high. Planet Products, Inc., 1501 S. Laflin St., Chicago 8, Ill.

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Fast and Easy Stripping

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Collyer Wires and Cables are engineered and laboratory tested for economical, speedy installation. On the job they are easy working . . . always uniform . . . and provide a quick, clean strip. Outer jackets are smooth and non-tacky for fast, easy draw. Convenient packaging saves time and eliminates waste, both in the stock room and on the job. Yes! Collyer is the choice of cost-conscious contractors who know it pays to buy the best in wire and cable.

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(4) **RUBBER INSULATED BUILDING WIRE** Available in all sizes and types to meet your needs—Type R, RH and RW, lead sheathed or braid covered for voltages to 5000 or higher.

(5) **VARNISHED CAMBRIC INSULATED POWER CABLES (Type V)** Built for heavy loading, resistant to oil, ozone and heat. Braided or lead covered, single or multi-conductor—voltages to 15,000.

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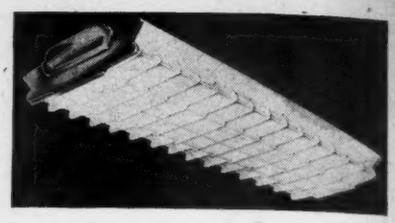
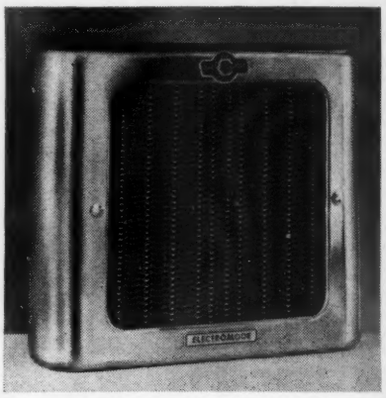


Lighting Unit

Two new companion type commercial fluorescent fixtures have been announced. The Lenox-2 accommodates two 48 inch 40 watt fluorescent lamps and the Lenox-4 is designed for four lamps. Units can be used for individual or continuous installations, and for either surface or suspension mounting. On suspension mounted continuous installations "A-J" hangers are supplied and are available in two standard lengths. Day-Brite Lightings, Inc., St. Louis, Mo.



Electric Heater

This fan circulating electric heater is specially designed for bathrooms and other small rooms. Known as the Bilt-in-Wall small-room heater, it can be installed in practically any type of wall construction, and connects to the regular 110 volt a-c house circuit. It is rated at 1320 watts. Fan distributes 80 cubic feet of heated air per minute. Heat is generated by a cast-aluminum heating element which has no exposed wires or glowing coils. Unit is equipped with a thermal safety switch. Electromode Corporation, 45 Crouch Street, Rochester 3, N. Y.

Photoelectric Counter

Photoelectric counter Type 20AP5 is a general purpose unit for installation on any conveyor system or automatic machine. The light source has an adjustable lens system which permits narrowing down the light beam for counting small objects. Unit includes light source, photoelectric control, and electric counter. Light source and electric counter are supplied with

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You don't need a dictionary to find out what RACO means to the electrical trade. The RACO Line is approved by the Underwriters' Laboratories, Inc. Contractors prefer the well known RACO quality. Architects specify the reliable RACO Line. Wholesalers enjoy the profitable repetitive volume.
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"UNION" PORCH LIGHT

BUG PROOF...VAPOR TIGHT

★ CAT. NO. 169

★ FOR 3¼" OR 4" OUTLET BOXES

★ 4¾" COVER DIAMETER

★ TAKES 100 WATT LAMP

★ LISTED BY UNDERWRITERS' LABORATORIES, INC.

Eliminates the unsightly collection of dust and charred insects that necessitates frequent cleaning of the conventional Porch Light.

This Vapor Tight Fixture protects lamp shell and socket interior from the corrosive action of salt laden atmospheres often found on the Sea Coast.

The corrosion resistance of the BLACK BAKELITE cover and adapter ring, protects the fixture from the most severe atmospheric conditions indefinitely.

The attractive pebbled glass globe assures light diffusion. Threaded top makes installation easy.

"UNION" PRODUCTS

Weatherproof Pigtail Sockets
Ever-Ready Pin Type Sockets
Insulated Conduit End Bushings
Insulated Entrance Bushings
Bakelite Outlet Boxes & Covers
Bakelite Lamp Receptacles
Hay Mow Lighting Fixtures
Pull Chain Lampholders

UNION INSULATING CO., INC.
PARKERSBURG, WEST VIRGINIA

cords and plugs which attach to the control. This has a line cord for plugging into any lighting circuit. One or more electric counters may be located anywhere in the plant, remote from the location where the count is being made. It plugs into 115 volt 60 cycle a-c standard light outlet. Photoswitch Incorporated, 77 Broadway, Cambridge 42, Mass.

Ceiling Fixture

Two circuit wiring and a central colouvered lens of clear glass are the features of this new ceiling fixture, called the Advance Pacemaker. It gives pin-point lighting on a dining table or other spot plus general overall illumination—either or both. It is 19½ inches in diameter and 4½ inches deep. The white ceramic background which surrounds the lens in center of fixture is etched in geometric patterns. Four designs are available. Lightolier, 346 Claremont Ave., Jersey City 5, N. J.

Fluorescent Fixture

The Eye-Q, is a new two 40 watt lamp fluorescent lighting fixture designed for schools, stores, offices and institutions. It is an all steel unit which contains no glass or plastic parts which might be subject to breakage, shrinkage or discoloration. Louvers open from either side and can be completely removed without screws, snaps, or other similar fastening devices. Ballast is mounted on slidable brackets, so that hanger stems can be positioned at any point along the four foot channel. Side reflectors swivel upward to permit cleaning of inner reflecting surfaces without removing lamps. Smithcraft Lighting Division, Chelsea 50, Mass.

Induction Motor

A three-phase squirrel cage Life-Line induction motor of weatherproof construction is available in ratings of ½ to 15 hp. (Frames 224 through

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SORGEL AIR-COOLED TRANSFORMERS

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Several advantages of our liberal design are—

Quiet operation
Low temperature
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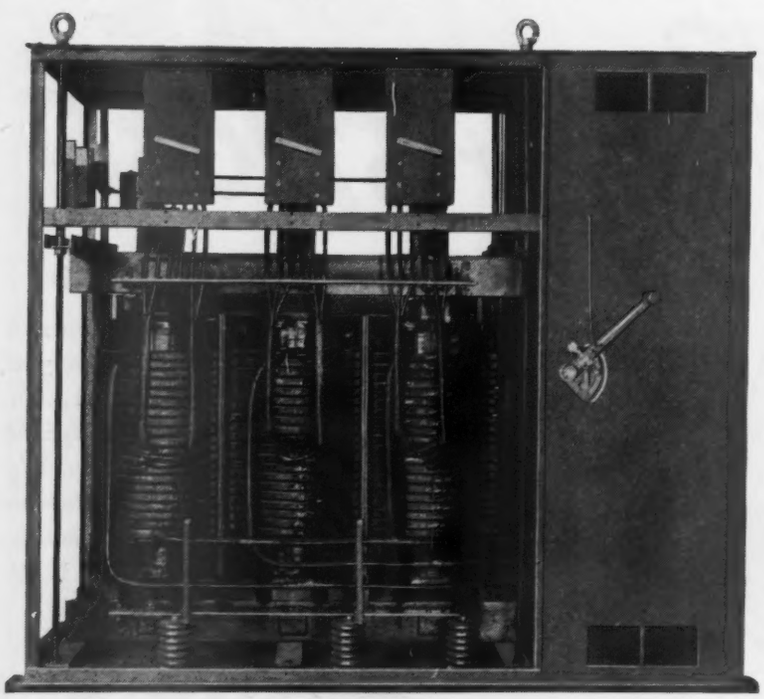
Long life

5 Kva. Single Phase 480/240 to 240/120 Volt Wall Mounting Type

Designed and constructed for easy installation.
A size and type for every purpose.
All voltages. 115 volts to 15,000 volts. ¼ to 1000 Kv-a.



300 Kv-a. 3-Phase, 13200 Volt Transformer. Part of Unit Sub-Station. (Enclosure Removed).

SORGEL ELECTRIC CO., 836 W. National Ave., Milwaukee 4, Wis.

Pioneers in the development and manufacturing of Air-Cooled transformers.

326). Motor is of all steel construction. Type CSP for outdoor oil well pumping service, utilizes the self-sealed, prelubricated ball bearings that provide effective lubrication for five years or longer without repacking. Tuffernell insulation with Tufvar wire provides maximum dielectric strength with high flexibility. Motors are available for 60 cycle, 3 phase, 220-440 volts, 900-1800 rpm, 40°C rise continuous duty open NEMA designs B and C and 50° C rise continuous duty open NEMA design D. Westinghouse Electric Corp., Pittsburgh, Pa.

New Equipment Briefs

A portable current **transformer** in the high current range has been announced by Westinghouse Electric Corporation, Pittsburgh, Pa. . . . Hobart Brothers Company, Troy, Ohio has developed a high frequency **stabilizer**, designed for use with a-c or d-c welders . . . A new portable **electric hand lamp** with built-in charger has been announced by U-C Lite Manufacturing Co., Chicago, Ill.

General Electric Company, Schenectady, N. Y., has announced the redesign of automatic **voltage stabilizers** in the 100, 250 and 500 va. ratings . . . For protective insulation in conduit installations and for sheathing a series of wires, Insulite **tubing** has been developed by Extruders, Inc., Culver City, Calif. . . . A new small electric **tachometer**, designed for continuous operation in industrial uses has been announced by the Electric Tachometer Corp., Philadelphia, Pa.

The Kester Solder Company of Chicago announces the development of "Resin-Five" core **solder** for all types of electrical and electronic soldering . . . A new line of oil-immersed selenium **rectifier stacks** has been announced by Ceneral Electric Co., Bridgeport, Conn. . . . A new illuminated pilot light bakelite **wall plate** is being manufactured by Eagle Electric Mfg. Company, Inc., Long Island City, N. Y.

O. Z. Electrical Manufacturing Company, Brooklyn, N .Y. has added three new **split couplings** to its line, ranging in conduit size from ½ in. up to 5 in. . . . Ingersoll-Rand Company, Phillipsburg, N. J. has announced the addition of "Pac-Air" to its line of portable **compressors** . . . Miller anular ball bearing **swivels**, designed by General Machine & Welding Works, Pomona, Calif., eliminates twist in wire rope.

Frank Adam Electric Company, St. Louis, Mo. has redesigned its LNTIP leader type **panelboard** . . . A multipurpose interval **timer** has been announced by the Haydon Manufacturing Company of Torrington, Conn. . . . A new phase-sequence **indicator** designed for a wide range of applications in the manufacturing, industrial and central station fields by General Electric Co., Schenectady, N. Y.

Going Great — where the going's tough

With several years of industry acceptance to back it—with a successful on-the-job record behind it, General Electric Thermoplastic Type TW wire has become a standard for permanently wet spots. Yes, G-E Type TW is a full-grown, code-accepted wire, with a record that shows it's going great where the going's tough.

Small-diameter Thermoplastic Type TW wire is proving every day that it can be used in permanently wet locations on jobs of all types. Underground—in concrete slabs or other masonry in direct contact with the earth—in locations where moisture is likely within the raceway, Thermoplastic Type TW does the job, and does it well.

When the going's tough, make sure that the job's done right with General Electric Thermoplastic Type TW wire. You'll like the way it does the job. You'll like the way it helps do your job, because it's easy to strip, easy to pull, clean to work with. Specify it by name—General Electric Thermoplastic Type TW wire.

For more information, write for the new, free booklet, *Building Wires, Cords, and Cables for every purpose,* to Section W14-1018, Construction Materials Department, General Electric Company, Bridgeport 2, Conn.

GENERAL ELECTRIC

AROUND THE CIRCUIT WITH YOUR G-E MERCHANDISE DISTRIBUTOR

SUPER PVX* nonmetallic-sheathed cable is the new development that's still creating a stir in the contracting field. *Good-looking,* it's a beauty for exposed wiring anywhere. Smooth brown or ivory finish makes it right for even the top-quality residential jobs. Its *tough* thermoplastic sheath and *rotproof* thermoplastic insulation make it a natural for fighting fumes and moisture in barns and other troublesome locations. Ask your General Electric merchandise distributor about SUPER PVX.

MACHINE TOOLS can't maintain a high production rate when portable cords are constantly breaking down. General Electric Flamenol* portable cords are made to keep tools on the job in spite of hard use. Thermoplastic jacket resists acids, oils, water, alkalies, and sunlight. Use them for replacements wherever tools have got to stay on the job.

LIGHTWEIGHT BX* armored cable with bonding strip in sizes 12 and 14 speeds construction because of weight reduction and increased ease of installation. These two new constructions and the rest of the General Electric BX armored cable line are still the old stand-bys for construction that goes in to last.

THE FULL LINE of General Electric wires, cords, and cables gives you a wide range of materials to choose from. For information on any part of the line, why not contact your General Electric merchandise distributor? He'll be glad to straighten out your supply problems, or simply give you how-to-do-it wiring facts.

*Trade-mark Reg. U.S. Pat. Off.

ORIENTATION ON THE JOB

[FROM PAGE 59]

ees. The first day of the course is devoted to executive and organizational details. Telephone and intercommunication systems are explained. Receiving and shipping procedures are outlined, including receipt of tools and equipment and methods for packaging and loading outgoing material. A visit to the tool room shows how these items are inventoried, lubricated, sharpened, repaired and issued to the men. In the warehouse he aids employees making endless belts and welding band saws. With the purchasing and procurement agents he discusses requisitions and pricing.

The second, and part of the third day is spent in the motor shops. Here the student follows procedures of receiving and shipping, handling emergency calls, testing and recording motor data, filing special forms and reports. The bin system in the shop storeroom is explained and, under qualified supervision, he winds, dips and bakes coils. Typical motors, large and small, are tested, stripped and repaired. Wednesday noon he attends a Lions' luncheon, meeting men of other industries. Then a brief visit to the bookkeeping department where routines connected with payrolls, taxes, union dues, time cards, checks and balances are explained. Three hours spent with one of Crowder's eight trucks gives first-hand knowledge of pick-up and delivery with skids, cranes and industrial trucks.

Thursday finds the student at the Easton office and shop, with the afternoon spent in the construction department. Here he discusses construction problems from a practical viewpoint, visits projects in progress, views industrial installations, residential wiring, high tension pole work and transformer stations.

On the final intensive day the student accompanies a sales engineer in the field, visiting typical customers, meeting maintenance men and operation personnel. He witnesses sales in action, observes recommended sales approach, evaluates customer relationships. Completing the course, he proceeds to still other departments to learn the facts about advertising, maintenance of office files, bill collection and credit establishment. A frank talk with Vice President C. F. Crowder reveals the history of the company, the general industrial picture of the entire Lehigh Valley area, the economics of a successful business, the growth and future of the electrical industry, and the various subdivisions of electrical contracting, supply, maintenance and repair.

At the end of each day the student records his impression of the course by dictaphone and, on completion of the course, students are rated as to initiative and interest by all Crowder employees who participated in the many sided program. Copies of dictaphone reports and ratings, with an analysis by the project director, are referred to the high school instructor for discussion and suggestions.

Dictaphone reports reveal the natural interest of the trainee, providing valuable data to project-supervisor Fred H. Taverna who can point out to the student specific advantages.

The course is proving definitely beneficial to students through effective vocational guidance and orientation. It is also returning premiums to Crowder in the nature of good will, civic acclaim and the creation of a potential source for obtaining trained and qualified employees in the future. The project is meeting with the enthusiastic approval and cooperation of students, faculty and company personnel. It is a shirt-sleeved, down-to-earth, practical enterprise that might serve as a pattern for similar ventures.

R. C. Hodges, electrical engineer for engineering-contractors Wigton-Abbott of Plainfield, New Jersey, firmly believes that the vigorous industrial construction activity of the present indicates a healthy overall expansion of the electrical field.

RESIDENTIAL SIGNALS

[FROM PAGE 65]

outlying clocks provided in the surface, semi-flush, modernistic or portable type. The various clocks may be located in the living rooms, dining room, library, bedrooms, kitchen, maid's room, garage, help's quarters etc. The systems may be of the minute impulse or synchronous motored types with the hourly corrective features.

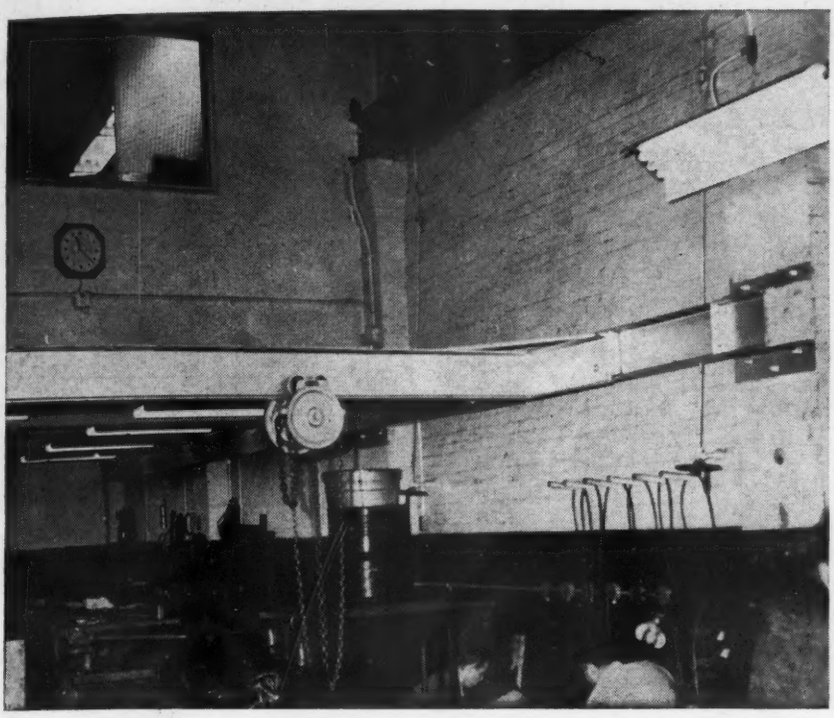
In and out systems are occasionally used in the very large and expensive homes, to indicate whether or not certain guests and members of the household are on or off the premises. These units are of the same type as those used in hospitals and consist of a specified number of illuminated cardholder compartments, one for each person who is to use the system, with a corresponding toggle switch for the control of each lamp.

Intercommunicating telephones may be used in practically any type of residence. A simple pair phone system may be used between the kitchen and the master bedroom, or between the kitchen and an outlying garage. A selective ringing-common talking system may be used to cover all points mentioned. In the larger home, a selective ringing-common talking system may be extended to other rooms such as living, recreation and maids' rooms. In the expensive home a selective ringing-selective talking system may include all of the points mentioned and extended to guests' rooms, help's quarters, gate house, summer house, etc.

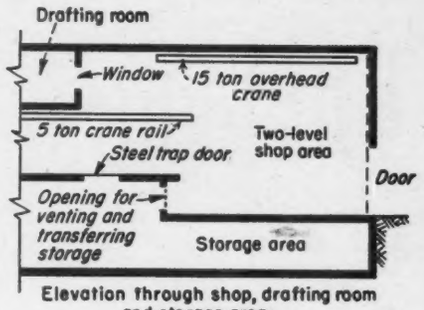
Paging systems are occasionally used in expensive homes or mansions. They are used to summon guests, members of the household and key domestics to a specified location to receive telephone calls, messages etc. These systems are of the silent type composed of small lamp annunciators marked from number 1 up to capacity and a central keyboard, with the annunciators located in living rooms, lounges, porches, near main entrance and main corridors. The keyboard is located at some central point in charge of an attendant. Code numbers are assigned to those individuals to be paged.

Centralized radio systems may be used in the large and expensive home. A two or three channel system may be used with loudspeaker outlets in guests' and host's bedrooms, living room, porches, reception rooms and at other locations. Such systems would include facilities for the playing of records and for public address.

Motor Shops



In addition to modern shop equipment, the area is lighted by 3-lamp fluorescent luminaires and heated by unit heaters. Drafting room, on upper level, is also air conditioned and equipped with acoustical ceilings.



Elevation through shop, drafting room and storage area

The shop area of the Davidson Electric Company is constructed on several levels. Thus, the storage area has two ceiling heights; the shop floor, in effect, has a raised loading-platform rear section, and the drafting and engineering room overhangs this rear section. Two cranes serve the area; a 15-ton unit for unloading material from trucks and aiding in heavy construction, and a 5-ton unit for transporting material and equipment to and from the rear of the shop area or storage vault.

Progressive Shop Has Modern Equipment

Repair and construction work progresses smoothly and rapidly in the shop of the Davidson Electric Company, Brooklyn, New York, with the aid of modern equipment. Two overhead cranes serve the shop area, a 15-ton unit for the main shop floor and a 5-ton installation for the rear section. Since the floor of the shop coincides with the outside street level, trucks can drive directly into the shop through the overhead sliding doorway, and material and equipment can be unloaded manually or by crane to either the floor of the shop or to the raised platform-level rear portion. The two-level construction, which existed when the building was originally occupied and modernized, provides a loading platform, a logical division of shop areas and also results in a sub-floor storage area with two ceiling heights. Material is removed from this storage area through either a steel trap door in the raised floor of the shop, or through an opening beneath the lip of the shop platform. This second opening, sheltered by the lip, is an excellent venting means for the storage area and also gives constant access to the storage area without leaving a condition that is productive of tripping or falling.

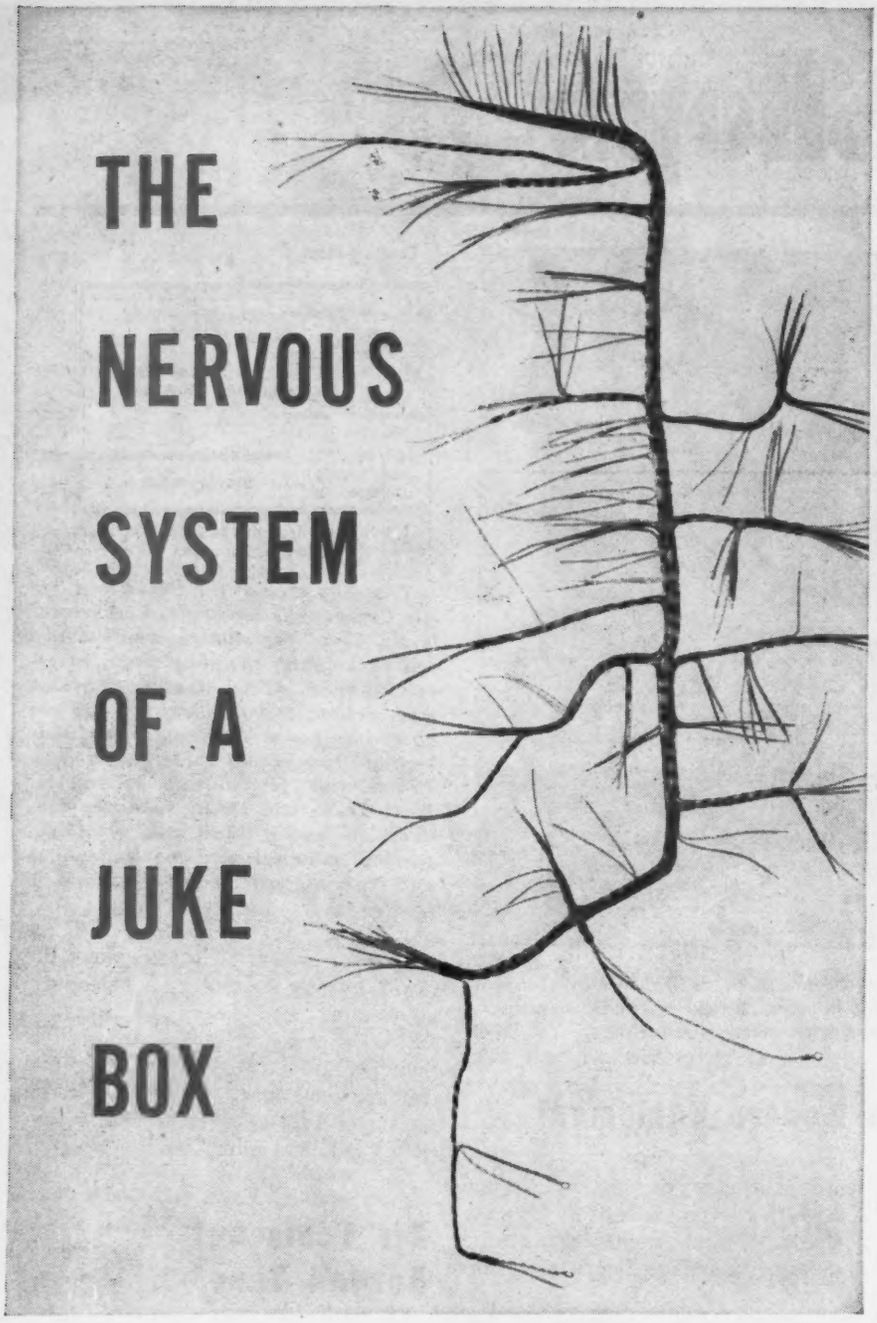
The Davidson engineering and drafting room is located slightly above the normal elevation of the second floor of the building and overhangs the rear section of the shop. A large plate-glass window in the drafting room can be rolled to one side when overall supervision is required in the shop and, with this window open, personnel in the engineering room can talk directly with men on the shop floor.

In addition to modern equipment, the areas are lighted by 3-lamp industrial fluorescent lighting units and heated with unit heaters. The drafting room is also air conditioned and equipped with sound-absorbing acoustical ceilings. In the shop area, fluorescent lighting units are mounted on an angle so that the lighting is directed out from the walls towards the center of the shop areas. Equipment for dipping, stripping, baking and testing of motors is located along the walls, leaving the center for unloading, assembling and heavy construction. Separate areas in other parts of the building are utilized for winding and for machine work. Office space is on the second floor, together with reception space and filing facilities.

Air Tools Cut Rewind Time

At present material and labor costs, motor repair shops are finding it more difficult to show a profit on their rewind operations. Management can still strive to improve shop organization and operating techniques. Long a proponent of trying out new ideas, the Willey-Wray Electric Company of Cincinnati, Ohio, never ceases to investigate possible labor saving schemes. The use of impulse air hammers on numerous operations is one idea that has more than paid for itself by boosting efficiency.

One of the first applications was the use of an air chisel to cut one side of stator coils prior to the stripping operation. This worked so well that the air hammer was adapted to other phases of rewind work. Now an air-operated file takes the sharp edges and burrs off stator slots. By substituting



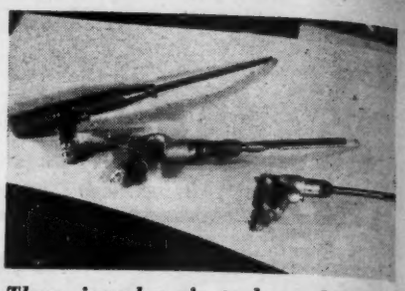
With its branching wires securely bound with No. 33 "SCOTCH" Electrical Tape with Vinyl Plastic backing there is no danger that the juke box whose harness is shown above will have a "nervous" breakdown. The flexible plastic backed tape does not come loose, does not permit wires to slip or shift, yet provides a completely flexible harness. Harnesses for automatic washers, traffic signals, burglar alarms, vending machines, and installations exposed to moisture or corrosive fumes, are given effective protection by half-lapped impervious sheaths of No. 33 "SCOTCH" Electrical Tape.

No 33 "SCOTCH" Tape has effected so many economies for others that it is a practical certainty that it will do as much for you. Write today for additional information.

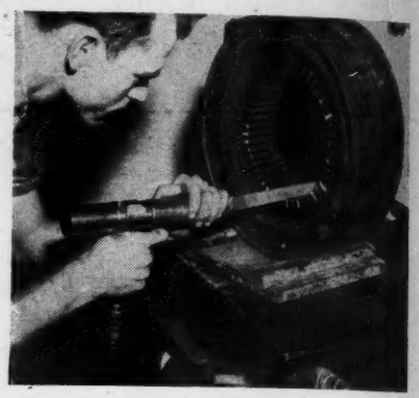
No. 33 SCOTCH Electrical TAPE

ANOTHER 3M COMPANY PRODUCT

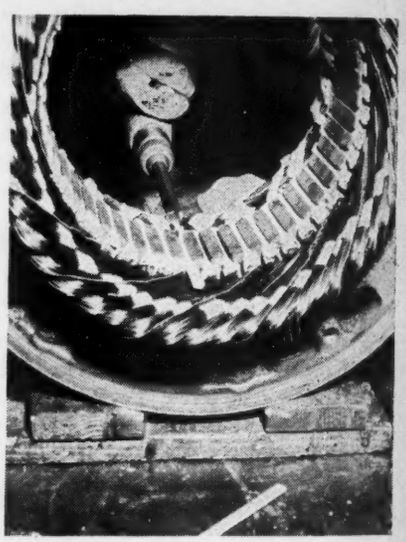
Made in U.S.A. by MINNESOTA MINING & MFG. CO. St. Paul 6, Minn.



Three impulse air tools used in the Willey-Wray shop are: (L to R) a file; a key-driver; and a key drifter.



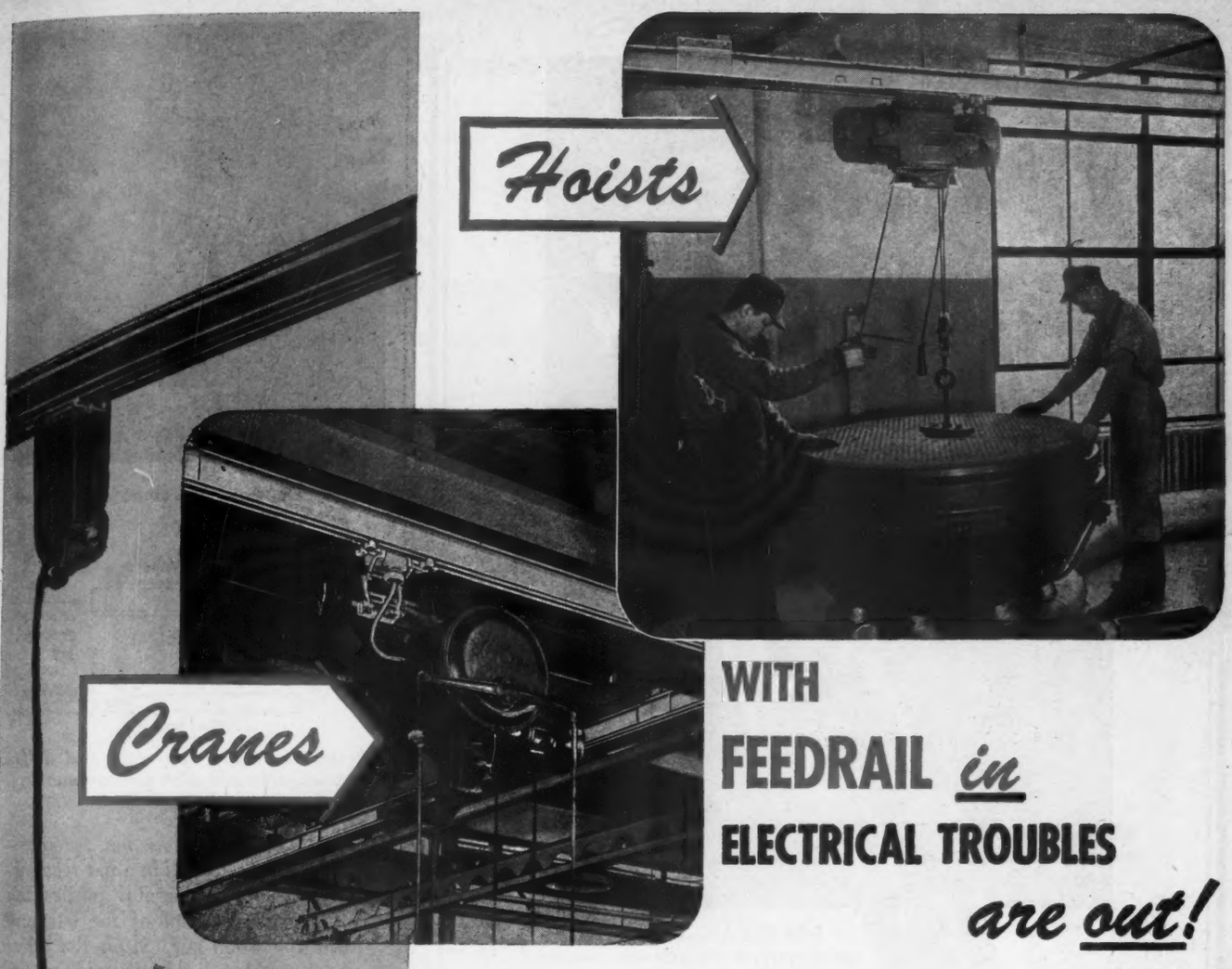
Dressing up stator slots with an impulse air hammer file. Same gun can be used with ordinary hacksaw blade to mill large commutators.



Air hammer with key-drifter tool removes wedges from a stator slot.

an ordinary hacksaw blade for the file, this air gun can be used for milling commutators too large to fit in the milling machine.

The Willley-Wray shop also uses air impulse hammers for drifting and driving armature slot keys (wood wedges to hold coils in slot). Two different tools are used. The key-drifter (for removing wedges) is a small rectangular steel bar just wide enough to ride in the slot. Its blunt nose is placed against one side of the wedge and the air hammer impulses drive the key out smoothly without damage to slot or coils.



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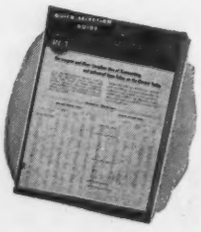
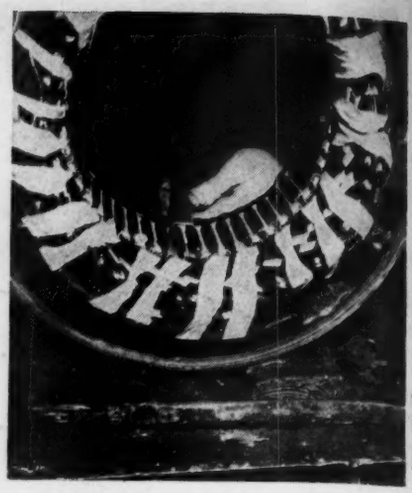


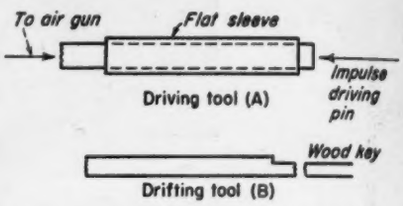
TUBE DEPARTMENT

RADIO CORPORATION of AMERICA

HARRISON, N. J.



Driving slot keys with impulse air hammer and driving tool.



Sketch of driving tool (A) and drifting tool (B) used with air hammers.

The driving tool is a flat rectangular steel bar that rides in a flat rectangular sleeve. The operator pushes the sleeve over the front of the bar and inserts the wood key. After the other end of the key is positioned in the stator slot, the impulse bar drives the wedge home. Since this bar is wider than the slot, there is no danger of over-driving the key. Besides guiding the key, this sleeve permits the operator to secure a good grip on the tool. One hand holds the sleeve, the other operates the air gun valve.

Vertical Rack Adjusts Belt Tension

In connection with testing motors of 20 hp. or less, a novel method is employed in the repair shop of the L. and P. Electric Company, Brooklyn, New York, to obtain the desired tension on the belt connecting the shafts of a standard motor and the motor being tested. As indicated in Fig. 1, the motor to be tested is rested upon a floor bed plate and securely bolted to the parallel slotted base bars. The belt is then passed over an accessory sheave which is affixed for test purposes. The standard motor (Fig. 2) is mounted on a vertical rig bolted to a structural building column and the motor is raised or lowered by means of a worm and gear assembly. The worm is turned by a pinion gear which, in turn,

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When it comes to electrical fittings, a century of foundry experience goes a long way in producing the kind of fittings contractors like to use. Gedney fittings are made of the highest grade, unbreakable malleable iron, smoothly finished and rust-proofed. They are designed to fit the job and packaged in convenient quantities in durable metal-edged cartons. Stocking Gedney fittings is good business for wholesalers because electrical contractors everywhere ask for them by name.

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Look at those smooth, accurate conduit bends shown in the photo above! They were made with GREENLEE Hydraulic Benders used on a recent installation by Emerson Garden Electric Company, Elizabeth, New Jersey.

J. G. Harrison, Superintendent of the company, in reporting on their experience with GREENLEE Benders says this: "We couldn't work without them. The GREENLEE can be relied on, day in and day out, for a first class job.

"Some of our GREENLEE Benders have been in continuous use for over 10 years and the savings they have provided over manual bending is tremendous."

Investigate the GREENLEE today. See how you, too, can make big time-savings . . . do the job faster, better.

The GREENLEE Hydraulic Bender is one-man-operated. Makes precise, neat bends in just a few minutes—in pipe up to 4½", rigid and *thin-wall* conduit, tubing, bus-bars. It's compact, portable, easy to set up and operate.

Get all the facts on this timesaving equipment, write for your copy of new free Bender Booklet E-201. Greenlee Tool Co., Division of Greenlee Bros. & Co., 1750 Columbia Avenue, Rockford, Illinois.

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OTHER GREENLEE TIMESAVING TOOLS FOR ELECTRICAL WORK

Hand Benders • Joist Borers • Cable Pullers • Radio Chassis Punches • Pipe Pushers

FIG. 1.—Slotted bearing bars and base plate, secured to floor of motor shop, support motor being tested prior to delivery to customer.

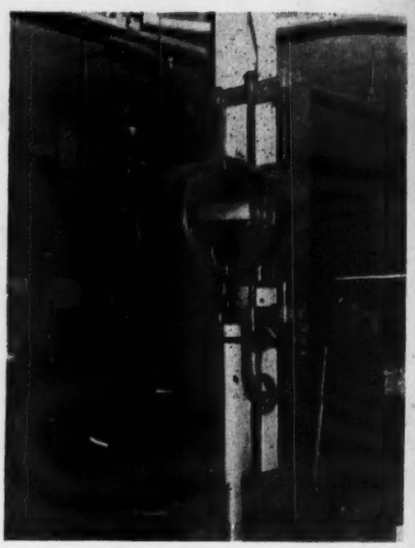


FIG. 2.—Tension on belt is adjusted by raising or lowering standard motor by means of lever—activated vertical worm assembly.

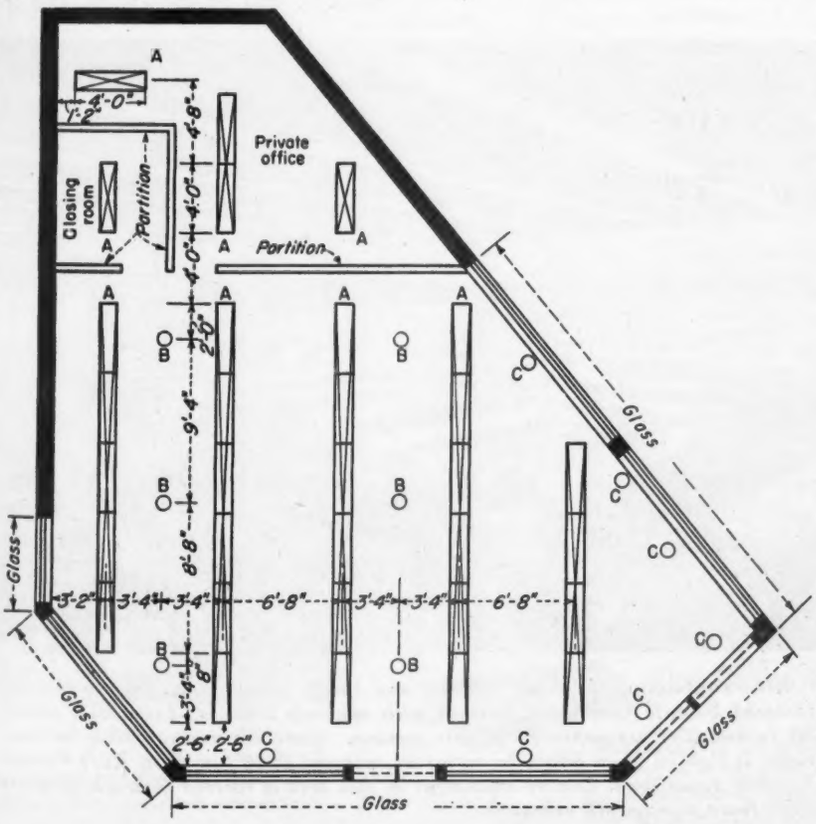
is activated by a hand lever and ratchet arrangement. By adjusting the height of the standard motor, the distance between the two motor shafts can be regulated, and the connecting belt can be stressed for the desired tension. The vertical rig keeps the testing motor off the floor, out of the way, insured against damage and resulting in additional floor space.

Transferring motors to be tested, from various sections of the shop to the testing area, is facilitated by means of an overhead monorail crane system which serves both the shop and loading areas. Switching arrangements make it possible to utilize tracks running to the particular area desired, and interlocks prevent hoists and their suspended loads from dropping from disconnected sections of the monorail system. Positioning and testing motors can be efficiently completed by a single operator.

Modern Lighting

FIG. 1—Semi-indirect Wakefield "Star" fluorescent continuous row units and 300-watt recessed incandescent units provide ideal lighting for display of autos in salesroom of Beikirch Bros., Hudson dealers in Rochester, N. Y.

FIG. 2—Lighting layout of irregular shaped auto salesroom. Fixture types: A—2/40-watt semi-indirect flourescent units; B—300-watt recessed reflector unit with diffusing glass roundel; C—300-watt recessed and louvered window reflector.



Diffused Light Sells Autos

Automobile dealers like to display their autos under the best possible conditions. From a location standpoint, that usually means a corner of a building with two glass sides, or an irregular shaped display room with open glass on as many sides as possible. From a lighting standpoint, a clear day outside is ideal, with direct light from the sun providing highlights on hardware and metal work, and diffuse light from the entire blue sky overhead providing glareless illumination over the entire auto for inspection of the body lines, finish and color.

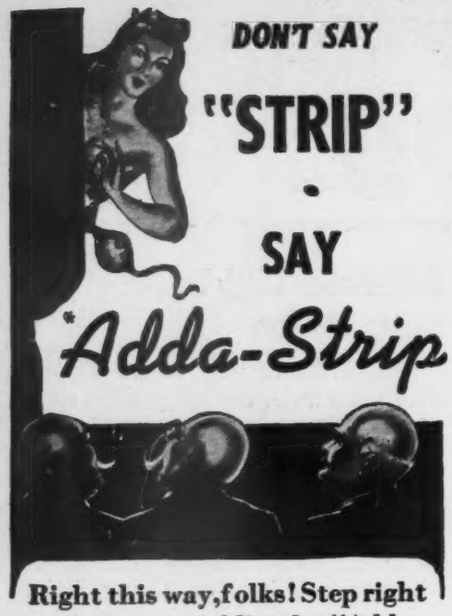
The Beikirch Bros. Hudson showroom in Rochester, N. Y., is no exception, so far as location is concerned. It occupies an irregular shaped first floor area (Fig. 2) with glass windows on three sides, which permits autos to be viewed from many angles by prospective customers outside the showroom.

Since it is impossible to bring the ideal natural outdoor lighting indoors, Beikirch Bros. have done the next best thing. They have installed artificial lighting which simulates natural outdoor light.

To provide evenly diffused, glareless light, such as might be obtained from the blue sky outdoors on a clear day, semi-indirect fluorescent Wakefield "Star" units are used. Installed in continuous rows spaced 6 feet 8 inches apart, and suspended 24 inches below the ceiling, these units light the 16-inch block Nuwood flat white ceiling evenly. The ceiling in turn reflects the light efficiently by diffuse reflection to provide ideal illumination for inspection of the car's finish, color and design lines. The 4500-degree white fluorescent lamps are used in all fixtures, providing a white light closely approaching daylight in color temperature.

To provide highlights on hardware and polished chromium parts and trim, such as might be obtained from direct sunlight, six direct lighting type incandescent reflectors were recessed flush in the ceiling. Each unit uses a 300 watt standard lamp. Heat resisting diffusing glass roundels shield the lamps and provide a neat, finished appearance to the units.

Seven 300 watt show window re-



Right this way, folks! Step right up and meet Addie, the "Adda-Strip" girl. Look for her at leading wholesalers. And remember don't say "strip", say "Adda-Strip". It's the password that saves you money in the long run ... and the longer the run the bigger the saving. 18 inches or 18 miles, Adda-Strip's unique construction features and superlative, precision-built quality add up to quick, inexpensive installations.

*ADDA-STRIP T. M. REG. U. S. NO. 394,728 U. S. PATENT NO. 2,434,781

No. 8000 Adda-Strip, 18" to 8 ft. lengths Completely wired and assembled including wire leads for splicing and feed.

No. X8000 strip at lower prices. Small end boxes, no wire leads.

FAST, ONE-MAN INSTALLATION

- Wired complete with ballasts, starters, sockets and lead wires.
- Covers snap on—hold without screws.
- Embossed screw-holes automatically line up ends and couplings.
- 8 ft. units save handling and splicing on continuous runs.

Adda-Strip is the most complete line, including single and double row for fluorescent or slimline and vest pocket strip for confined areas. Accessories include reflectors, hinged louver shields, louver and plastic shielding combinations.

GARCY America's leading manufacturer of strip lighting

GARDEN CITY PLATING & MFG. CO.
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flectors were installed flush in the ceiling at the window glass line, to direct light asymmetrically back to the autos on display. Concentric louvers in each unit prevents glare from spill light for persons inside the salesroom, or looking through the glass windows on the opposite side of the salesroom.

A maintained lighting intensity of 35 footcandles average is obtained from the combination of fluorescent and incandescent units, exclusive of the window lighting. The light finished polished terraza floor reflects light back onto the sides of the autos on display, which aids in close inspection. Finish of woodwork is bleached oak, and of the plaster walls is very light green, both with high reflective factors.

D. Q. Faragher, Rochester architect, designed this lighting installation and decorative treatment, in cooperation with the Lighting Division of the Rochester Gas & Electric Corporation.

Food Market Sells With Light

A group of 24 Lucky Stores situated along the west coast is establishing a pattern of high-intensity lighting for the effective presentation of food products. Two of the first stores to be completed are located at San Leandro and San Bruno, California, and their claim to the distinction of being "the world's brightest food market" is backed by a lighting plan that delivers over 100 footcandles to merchandise counters and shelves. These two stores, with identical floor plans and styling, were designed by Raymond Loewy Associates, industrial designers. Not only was lighting considered a definite part of the architectural plan, but layouts of the various areas, and designs for lables, directories and all standard equipment were planned to harmonize with the general treatment of these stores. Each store, approximately 280 feet in both directions, represents an investment of over $300,000.

Only one of the four exterior walls is completely solid and the liberal use of huge plate glass areas on the other three sides displays the interior to pedestrians and passing motorists. In effect, the walls are show windows and the treatment of the interior is projected to the under side of the canopy over the surrounding sidewalk areas. This is accomplished by carrying the ceiling troffer patterns through the glass walls as unbroken lines of light.

Two lighting installations are used to illuminate the central portion of each store. Continuous rows of 4-lamp 40-watt Sylvania fluorescent fixtures are ceiling-mounted on 8-foot centers above the general merchandise shelves. Fixtures are equipped with plastic sides for horizontal diffusion while the bottoms of the fixtures are fitted with eggcrate louvres. Initial intensities in this area were 110 footcandles although, after 600 hours of service, this level was reduced to an average

Area containing checking stations and lunch counters is illuminated by recessed 2-lamp fluorescent fixtures with eggcrate louvres. Intensities above 80 footcandles are achieved in this section. Store directory, visible at rear right, is lighted from above by series of recessed R-40 lamps in Kurt Verson Focalite mountings. Louvre treatment in this area is carried through all-glass store front to sidewalk marquee.

THE NEW
ALL-METAL
2-40 Watt

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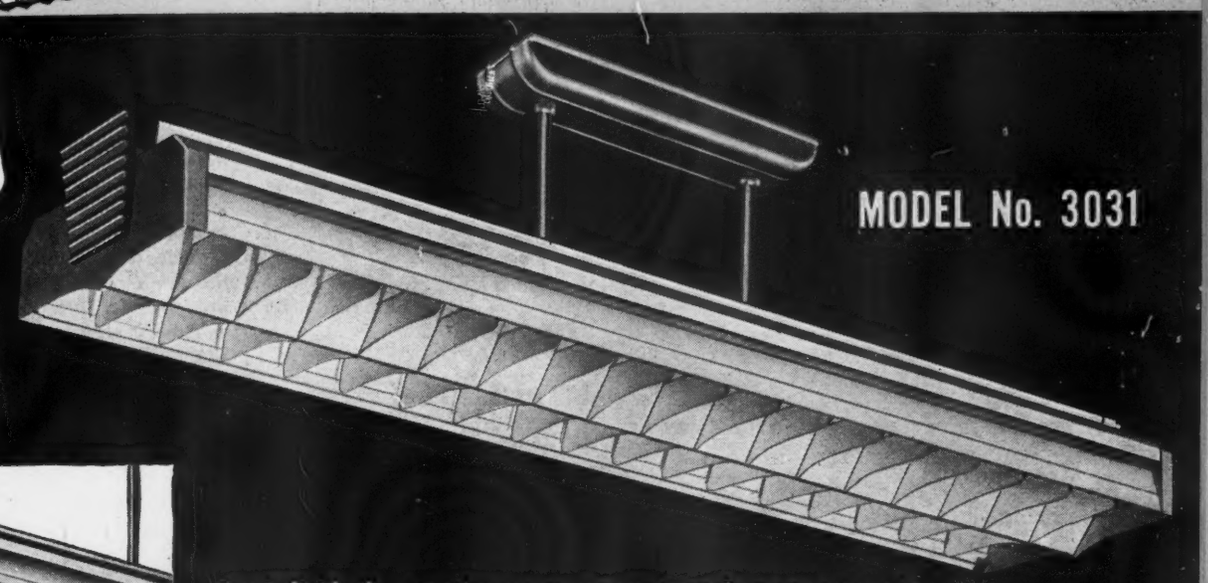
School Lighting Unit
Scientifically Engineered for Efficient Classroom Lighting

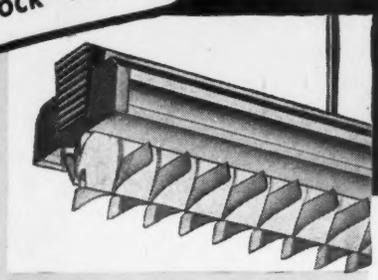
NO GLASS TO CLEAN OR BREAK



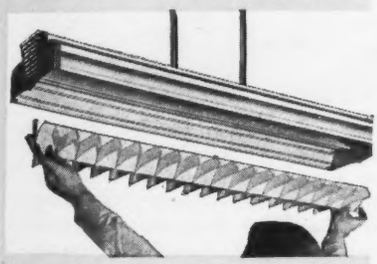
MODEL No. 3031

For individual or continuous row mount, surface or suspension

EXCLUSIVE "2-POSITION LOCK" LOUVER



Louver drops smoothly on two slotted hangers at the flick of a finger. Makes relamping and cleaning quick, simple and safe. Louver cannot drop out accidentally.



Louver may be removed instantly, by simply pressing slotted hangers. Easily snaps back into position in a jiffy. An exclusive MITCHELL feature.

Ideal illumination for the modern classroom. Provides abundant, glare-free light, uniformly distributed. Prevents eye-strain and fatigue, steps up school efficiency.

Lowest Cost! Better Light! Less Maintenance!

Here is the Fluorescent Luminaire that brings truly economical and super-efficient lighting to classrooms, libraries, public buildings and institutions. MITCHELL Model No. 3031 is scientifically designed to provide high light output with low brightness contrast, free of eye-tiring variations in light intensity. Features efficiently designed louver and indirectly illuminated sides which eliminate dark areas.

The Model No. 3031 unit is constructed entirely of metal—has no glass shielding or panels to break or clean. Smooth design of all vertical surfaces on louver, sides and ends eliminates dirt accumulation; there are no horizontal glass surfaces to gather dust and dirt. An exclusive feature of the gracefully contoured louver is its special locking and hanging principle that greatly simplifies maintenance. Just the flick of a finger releases the lock, allowing the louver to slide down into an open position on two slotted hangers. This feature prevents accidental dropping of the louver, and permits quick, simple relamping and cleaning. When desired, the louver may be completely removed simply by pressing the slotted hangers. Top reflector rails are easily removable for immersion washing.

Model No. 3031 may be flush or suspension mounted, individually or in continuous rows. Finished in Baked White Enamel, with Satin Aluminum decorative metal end pieces. Uses latest E.T.L. Approved Brick Type Ballasts (High Power Factor). Dimensions: 48⅛" long, 11⅝" wide, 5¾" deep (see detailed dimensional drawing on other side of this sheet). Completely wired, ready to hang. Knockouts and holes are provided for easy mounting. For individual suspension mounting, use Double Stem Set 032ST. For continuous row suspension mounting specify Single Stem Set 031ST (number required: one more than total number of units in row). Individually packed. Operates on 110-125 volts, 60 cycle Alternating Current. Approved by Underwriters' Laboratory.

MITCHELL *First Choice in Lighting*

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In Canada: Mitchell Manufacturing Company, Ltd., Toronto, Canada
Far West: *Complete Modern Plant and Sales Office at Los Angeles Serves the Entire Pacific Coast Area*
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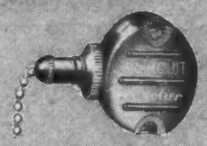
The high quality and long life of LEVOLIER switches have been proven many times in actual service in the field. Nationally known manufacturers have reported that Levolier switches have been pulled on and off more than 180,000 times under normal load without a miss, and are still in excellent condition. These field performances show that Levolier switches surpass the Underwriters' Laboratories requirements by three or four times.

McGILL LEVOLIER switches are precision built. Every single part is carefully machined so that you are assured of maximum life and dependability! Widely used on variable speed motors, canopy and outlet box mounting, ventilating fan installations, sign flasher boxes, and transformer boxes, they provide positive control from any angle.

A complete description of the many types and sizes of LEVOLIER Switches is found in McGILL catalog No. 43. Send for free copy today.

No. 1010—10 amp., 125 volt fluorescent control. Special "T" rating.



No. 201—3 amp., 125 volt, 2 circuit canopy pull switch.

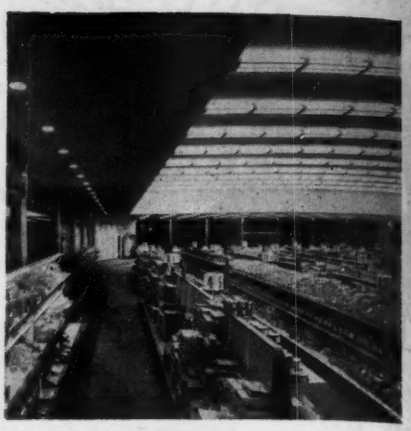
No. 25—6 amp., 125 volt toggle switch. Single pull wire leads, "T" rating.

No. 265—6 amp., 125 volt. Double pole, double throw.

McGILL MANUFACTURING CO., INC.

Electrical Division

450 N. CAMPBELL ST. VALPARAISO, INDIANA



General merchandise area is illuminated by 4-lamp ceiling-mounted fluorescent units having plastic side panels and eggcrate-louvred bottoms. Recessed 150-watt R-40 lamps build up lighting level immediately inside windows. Over 100 footcandles are achieved in this area. Illuminated department signs and in-built strip lighting over wall shelves and cold chests further facilitate shopping and highlight merchandise.

Color correction and added intensity is achieved over vegetable bins by combining recessed R-40 lamps with continuous rows of 4-lamp fluorescent ceiling-mounted fixtures. Adjacent parking area is illuminated by series of 1500-watt floodlights mounted on store roof. Canopy over adjacent sidewalk is lighted by glass dishes, 16-inches in diameter, 6-inches deep, and lighted by 3-lamp units of 60-watt incandescent bulbs.

of 101 footcandles. The second major area contains checking stations and U-shaped lunch counters. This section is illuminated by parallel rows of recessed 2-lamp 40-watt units mounted end to end and louvred with larger eggcrates than those used in the 4-lamp fixtures. A lighting level of 80 footcandles is achieved in this area.

To build up the attention-compelling level of light immediately inside the exterior glass surfaces, 150-watt R-40 reflector floodlights are recessed

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THIRD INTERNATIONAL LIGHTING EXPOSITION and CONFERENCE
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NAME OF MANUFACTURER
COMPLIANCE WITH SPECIFICATIONS UNDER APPROVED INSPECTION OF OUR RLM STANDARDS INSTITUTE BY THE ELECTRICAL TESTING LABORATORIES, INC.

Whenever your LIGHTING PLAN calls for one or more of these eleven popularly employed lighting units, RLM labeled equipment insures you of units made to conform to important standards relating to lighting equipment efficiency, ease of maintenance and long life. They cover . . . (1) Materials (2) Reflection Factor (3) Construction (4) Photometric Performance (5) Accepted Criteria (6) Auxiliary Control Equipment Standards (7) Conformance to National Electrical Code.

No lighting unit can bear this RLM LABEL unless continuous compliance to RLM specifications has been determined by the Electrical Testing Laboratories. For a COMPLIMENTARY COPY of COMPLETE RLM SPECIFICATIONS for ELEVEN INDUSTRIAL LIGHTING UNITS, write any of the manufacturers listed below or address your request to RLM STANDARDS INSTITUTE, Suite 819, 326 W. Madison Street, Chicago 6, Ill.

consult this latest
CHECK LIST
Released by
Electrical Testing Laboratories *

INCANDESCENT UNITS*					FLUORESCENT UNITS*					
					CLOSED END			OPEN END		
Spec. No. 1 Dome	Spec. No. 2 Deep Bowl	Spec. No. 3 Symmetrical Angle	Spec. No. 10 Glassteel Diffuser	MANUFACTURER	Spec. No. 5 2-40 W Lamps	Spec. No. 6 3-40 W Lamps	Spec. No. 7 2-100 W Lamps	Spec. No. 8 2-40 W Lamps	Spec. No. 10 3-40 W Lamps	Spec. No. 11 2-100 W Lamps
X				Appleton Electric Company						
X	X	X	X	Benjamin Electric Mfg. Co.	X	X	X	X	X	X
X				Bright Light Reflector Co.				X	X	X
				Day Brite Lighting, Inc.	X	X		X	X	X
X				Jones Metal Products Co. (Abolite)						
X				The Miller Company	X	X	X	X	X	X
				Mitchell Manufacturing Co.	X	X		X	X	
X				Overhagh & Ayres Mfg. Co.						
X	X	X	X	Quadrangle Mfg. Company						
X	X	X	X	Smoot-Holman Company	X	X		X	X	X
				Sylvania Elec. Products, Inc.				X		X
X	X	X	X	Westinghouse Electric Corp.	X	X	X	X	X	X
X	X	X	X	Wheeler Reflector Company	X	X	X		X	X

*Based upon Report for the Fourth Quarter of 1947 and supplementary reports by Electrical Testing Laboratories, Inc., the independent testing agency of the Institute.

** *Spec. #22 covers a new 2-40 W fluorescent longitudinal shield unit.* R-2932 SRR

* *Electrical Testing Laboratories, Inc., 2 East End Ave., New York 21, N. Y.—an independent testing organization, serving American industry for 50 years and responsible for the inspection and certification of lighting units to* RLM *Specifications. Fourth Quarter Report above shows manufacturers who can supply lighting units made in accordance with* RLM *Specifications as indicated by (X).*

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P&S 1565 — Same body as P&S 1560, but with wide mounting ears for easy alignment with wall surface.

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P&S 1570 — Double grip contacts —All-Bakelite construction—Wide mounting ears with break-off washers — Attractive Uniline design on face. Meets REA and Federal specifications.

BEST

P&S 1530

P&S 13202

P&S 1530 — Positive one-piece contacts — Sturdy all-bakelite construction — wide mounting ears. T-slots. Meets REA and Federal specifications.

P&S 13202 — Double grip contacts — Plate fastened by 2 screws — Permits a matched P&S-Despard installation. Meets REA and Federal specifications.

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around the border of each store in Kurt Verson Focalite mountings. By this treatment, intensities are again raised above the 100 footcandle level. This same treatment is also used over the vegetable section and, in addition to highlighting the fresh produce, color correction is achieved by blending incandescence with the predominant fluorescent lighting.

To facilitate shoppers, a large store directory is located in a corner of each store, adjacent to the main entrance. This directory is illuminated by a row of R-40 lamps, ceiling recessed 4-feet in front of the directory. Locating specific sales areas is further facilitated by illuminated department signs and in-built strip lighting over shelves and refrigeration chests.

The installation pictured in the illustrations was performed by the Central Electric Company for Daley Brothers, general contractors.

Good Light Aids Book Sales

Good light is a sound investment. In a store, for example, the value of good lighting can be appraised from an investment standpoint on the basis of comparison of the daily owning and operating cost with increased daily sales. This type of appraisal is factual, and can be made by any store owner based on data in his files.

The value of good lighting may also be appraised on an artistic basis, involving appearance, color quality of the resulting illumination, the ease of seeing or seeing comfort, and other similar psychological and physiological factors. The yardstick for this type of appraisal is less specific, but exists and is of equal importance to the store owner.

The Personal Book Shop in Newtonville, Mass., embodies many factors of good lighting. General illumination of a well diffused uniform intensity throughout is provided by fluorescent lamps and reflectors installed over the wall cases, producing indirect lighting. This general lighting is supplemented by high intensity direct lighting on the front of the bookcases along the two side walls. Fluorescent lamps installed in reflectors concealed behind a baffleboard at the outer edge of the top of the cases provides this direct lighting, causing the book displays to stand out in sharp contrast.

Lighting intensities range from 32 to 40 footcandles in the main floor area. Vertical intensities on the wall cases vary from 90 footcandles on the top wall case shelf to 50 footcandles on the second shelf, and to 20 footcandles on the third shelf. The horizontal intensity on the bottom shelf is 35 footcandles.

It is estimated that the sale of one additional $5.00 book daily will more than pay for this lighting installation, including daily fixed and operating costs.

Thomas Byrd Epps of Boston was the architect for this book store. Litecontrol furnished the lighting equipment, and Paletz Electric Company, of Boston, were the electrical contractors. The Lighting Department of the Boston Edison Company cooperated in the design and layout of the lighting installation.

Indirect general lighting supplemented by direct lighting on book shelves creates mood conducive for book sales at the Personal Book Shop in Newtonville, Mass.

Questions on the Code

Lighting Circuits

Q. *The Code used to contain a provision which made it necessary when wiring store buildings to limit the load on the lighting circuits to 80 percent of the branch circuit rating. This was found under Section 2107 of the 1940 Code. Now I cannot find such a ruling in the 1947 edition. Can you explain why this was removed, or have I just missed it in the new Code?*—R.A.E.

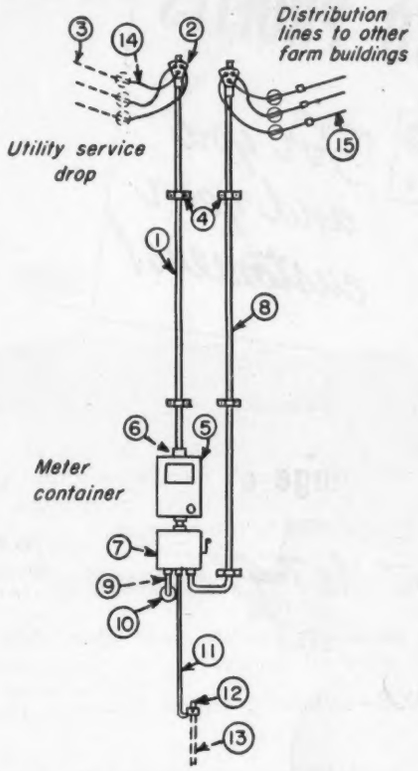
A. The intent is still the same. However, the wording has been changed somewhat. This rule will now be found under Section 2116 of the 1947 edition of the N. E. Code. This section is as follows: "The branch circuit load for lighting and appliances shall be computed in accordance with the provisions of this section. Where in normal operation the maximum load of a branch circuit will continue for long periods of time, such as store lighting and similar loads, the minimum unit loads specified in this section shall be increased by 25 percent in order that the wiring system may have sufficient branch circuit and feeder capacity to insure safe operation."—G.R.

Farm Service

Explanation: A centrally located building (in a Farmstead group under one management) has been selected as the Main Service Entrance location. The equipment is to be installed on the outside of the building wall.

The utility company serving the farm requires a disconnecting means (7) for the whole system. An unfused switch is a rather uncommon piece of equipment in the community and it is decided to use a-pole (3 wire) raintight circuit breaker. The incoming S. E. Cable (1) and the outgoing cable (8) are the same size. Overhead open wires (15) serve the other buildings. This building has its own protective devices just inside the building wall.

Q. *Does the code prohibit connection of the outgoing cable (8) and the building S. E. (9) to the same "load" terminals in the Main Breaker*



① Incoming S.E. cable
⑥ W.P. box connector
⑦ Main disconnect (may be unfused, fused switch or circ. brkr.)
⑧ Outgoing S.E. cable to supply other buildings.
⑨ S.E. cable, feeder to this building's service equipment
⑩ Sill plate - at cable entrance point
⑪ ⑫ ⑬ Grounding equipment

(7) or must the Main Breaker consist of two (2-pole) breakers?—L.A.W.

A. Inasmuch as service equipment is installed in each building at the point where the service enters, no service equipment is required on the pole on which the meter is located. However, neither service equipment nor a main disconnect switch (with or without fuses) would be prohibited, and certainly a disconnect switch at this point would add to the safety of the installation and is recommended.

The Code does not prohibit connecting all of the loads (that is all of the outgoing cables to the various buildings) to the load terminals on the main disconnect switch (or breaker) and a single two pole switch (or breaker) is sufficient.—F.N.M.S.

Conductor Identity

Q. *The question of conductor identity on switch loops where cable is used is causing some trouble on this project. Must we use a three conductor cable and leave the white wire unused, or can we use the two conductor cable and use the white wire for the return conductor for the switch loop? Then on small single phase 230 volt motors the same problem also arises. What does the Code require?* —M.L.

A. On a nonmetallic sheathed cable installation a two conductor cable may be used for a switch loop providing the unidentified conductor is used as the return conductor from the switch to the light outlet controlled. This makes it possible to use the identified white conductor as the current carrying conductor to the switch from the circuit.

Whenever one wishes to use a two conductor cable with both conductors tapped to the outside legs of a three wire system, the National Electrical Code requires that the identified wire be rendered permanently unidentified at the terminals. This may be accomplished by painting the white or gray conductor some other color.

Both of these rulings will be found under Section 2006 of the N. E. Code. —G.R.

Disconnect Switch

Q. *Our local inspector demands a main line service disconnect switch ahead of the multibreaker whenever the breaker consists of more than six circuits. My interpretation of this is that he has confused branch circuits with subdivision of the service. Who is correct?—A.A.*

A. The inspector is correct in his statement that a main line switch or breaker must be used ahead of a distribution cabinet supplying more than six circuits protected by individual circuit breakers. This ruling will be found under Section 2351-a of the National Electrical Code. In a dwelling or any other small building

General Electric precision engineering in this new low-priced ($12.45 list) Handy Time Switch will help sell your customers and keep them sold. Features like the large silver contacts and the reliable Telechron motor (synchronous, self-starting, and permanently lubricated) give long-range customer satisfaction, and help keep service calls to a minimum.

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SAVES ELECTRICITY—*Lights and appliances operate only when wanted, are turned off automatically when not needed.*

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SAVES TIME—*Control of motors and machines releases operators for other essential work.*

During any 24-hour period, the T-47 performs one ON-OFF operation (maximum On 22 hrs., minimum 5 min). It will continue to do so day after day without any further adjustment.

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GENERAL ELECTRIC

in which the entire electrical installation consists of six circuits or less, the individual circuit switches or breakers actually become subdivisions of the service when there is no main line switch or breaker ahead of them.—G.R.

Bonds At Service Equipment

Q. *Our local electrical inspector informs us that it is not necessary to bond service equipment on 120-240 volt single phase grounded neutral system other than with single locknuts and bushings. As I have wired for 30 years and have seen large conductors in conduit burned off with grounds from overhead wires being down from storms, I wonder what would have happened if these services had to depend on this single locknut and bushing bond to carry this large amount of current.—G.W.H.*

A. Sections 2571 and 2572 cover the above point in question. In these sections we find that the service raceways (conduits) or service cable armor or sheath and all service equipment enclosures interposed in the service run and any conduit or armor forming part of the grounding conductor, must be bonded together by bonding all with the grounded service conductor or by means of threaded couplings or threaded bosses on enclosures for conduit, or by means of threadless fittings for electrical metallic tubing or by means of bonding jumpers or by means of other devices, but not *locknuts and bushings*, approved for the purpose.

Note that the last part which is taken from 2571e specifically does *not* recognize locknuts and bushings as being sufficient.

Also note that with concentric knockouts, bonding jumpers must be used (2572d).—F.N.M.S.

Lighting Fixture Wiring

Q. *When fluorescent fixtures are hung on an existing installation, does the Code make it mandatory to suspend them from the ceiling if the original wiring in the outlet boxes is not replaced?—B.K.*

A. It is presumed that the installation in question was wired with Type R conductors and that the temperature of the fixture canopy is such as to bring about a temperature

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Lamps: 2, 4, 6 or 8 Slimline lamps at 120ma, 200ma or 300ma.

Mounting: Surface or suspended with illuminated sides; or inset level with ceiling or false ceiling.

Finish: High reflectance "Klasium" white —another LPI exclusive.

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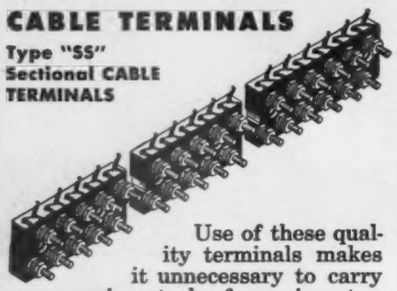
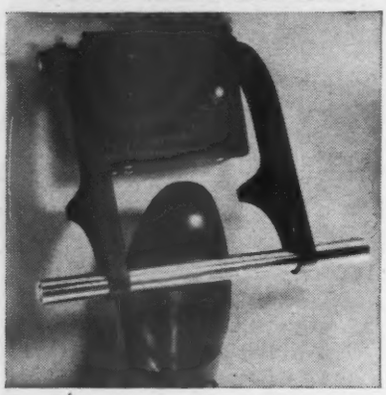
CABLE TERMINALS

Type "SS" Sectional CABLE TERMINALS



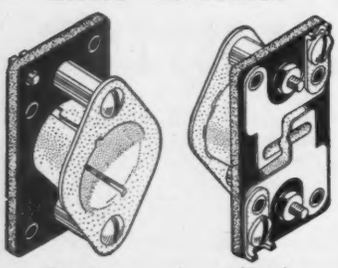
Use of these quality terminals makes it unnecessary to carry an excessive stock of one-piece terminals of different sizes. Six pair end section, 5 pair center section and 5 pair end section, with or without solder lugs. *Shown on Page 27, with prices.*

FOOT RAIL ALARM



For banks, post offices. Connected with visual warning signs or bells, alarm is sounded by raising toe under rail. Ruggedly built for long life. *(Shown on Page 26.)*

LAMP SOCKETS



(Front) (Rear)

Bayonet type shallow mounting lamp sockets, using automobile type lamp. Single and double contact types. . . *(Shown on Page 27.)*

NEW LOCKING PUSHBUTTON

Type HLS (Pushbutton only)

(Not shown in C-47 but described in Bulletin HLS-1.) Reset type. For bedside calling stations. Ideal for replacement on systems equipped with old type buttons. Small, light, with plastic shell and metal end bell. Cord entrance provided with fatigue rubber grommet.

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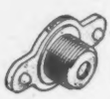
CNT-1U Box Connector Reversible Type

CF-1U-½ CF-2U-¾ Conduit Connector

Both listed as approved by Underwriters Labs. Popular items. Moderately priced. Millions sold.

CR-1 Thin Wall Connector



FS-2 FS-3 Fixture Stud

CR-1 for ½" EMT conduit. Fixture stud is a time-saver; no bolts needed.

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within the outlet box over which you wish to hang the fixture of more than 140 degrees F.

When such conditions exist, the N. E. Code does not say you must use only a suspended fixture. However, it, does mean just about the same. This may be found under Section 4179 which reads as follows: "Conductors having insulation suitable for the temperature encountered shall be used. Where conductor temperatures are in excess of 140 degrees F, conductors shall be brought through at least four feet of metal raceway from the fixture to an outlet box at least one foot from the fixture. Such conductors, unless approved for the purpose, shall not extend a distance of more than six feet from the fixture as measured along the raceway." In other words, such a fixture cannot be surface mounted over an outlet box containing Type R conductors if the temperature within the box is raised above 140 degrees F.—G.R.

Outdoor Wiring

Q. *We are planning to wire an outdoor athletic field and have been advised that it will be necessary to provide a disconnecting switch for each pole supporting the lighting fixtures. Where will this rule be found in the Code?—J.A.N.*

A. The N. E. Code has been prepared for the wiring of buildings and therefore as yet has not attempted to cover fully such installations as the lighting of an athletic field. It is true there are some references in this Code to such a system, but the requirement for a disconnect on each pole or structure will be found in Section 308 of the National Electrical Safety Code. This is a definite life saving requirement making it possible to replace broken bulbs during such time as the athletic field is being used.—G.R.

Non-Retroactive Rules

Q. *Is it necessary to install a separate branch circuit of not less than No. 12 wires for a receptacle to be installed in a kitchen if no appliance branch circuit exists in an already wired house or does this rule only apply to new construction?*

If no appliance branch circuit exists or no spare fuses are available at the fuse box, does the code require that the existing fuse box be removed and a larger fuse box installed so that a

for better fluorescent lighting

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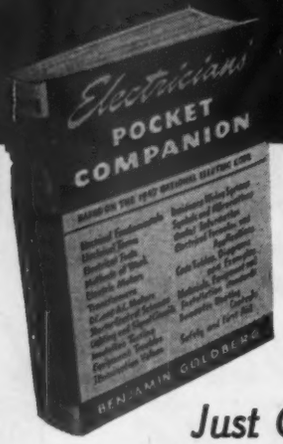

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Occupation .....

separate branch circuit can be provided for the kitchen receptacle?

I have seen articles recently in home magazines showing fluorescent lighting fixtures for kitchens to be installed over work tables and shelves with a built in receptacle. This seems to be a violation of the intent of the code unless this exception is made for existing or already wired homes.—E.E.S.

A. In a residence already built and wired and no changes being made either structurally or electrically, the code, not being retroactive, would not require the installation of the No. 12 wire appliance circuit.

If however, additional receptacles were to be installed for the use of small electrical cooking appliances, laundry equipment, etc., then a No. 12 wire appliance circuit should be provided.

Where an extra circuit is required or is desired, it would not be necessary to remove the present panel and install a larger one as the present one could remain and another small panel (possibly a one-circuit one), could be added.

There are many fixtures and appliances advertised and sold which are not approved but until there are sales control laws, not much can be done except missionary educational work.

Fixtures embodying a built-in receptacle as described above, should be wired to and wired with (at least to the receptacle, with No. 12 wire and this receptacle should not be on the same circuit with the light.—F.N.M.S.

Conductors in Conduits

Q. *What type of insulated wire should we use in underground conduits serving gasoline pump islands at filling stations? In the past we have used lead covered wires, but in this climate the life of a lead jacket is not very long due to the freezing and thawing which seems to open the sheath.—A.C.P.*

A. Section 5142-d of the Code states that "Conductors in conduits entering or leaving the dispensing pumps, when covered with a rubber compound or other compound upon which the dispensed liquid will have a deleterious effect, must be sheathed with a suitable material such as lead". It is true that lead sheathed conductors are unable to furnish satisfactory life when subject to freezing and thawing when located in conduits containing moisture. As a result many inspection agencies have approved the use of Type TW conductors for such use uroviding the label on the coil indicated

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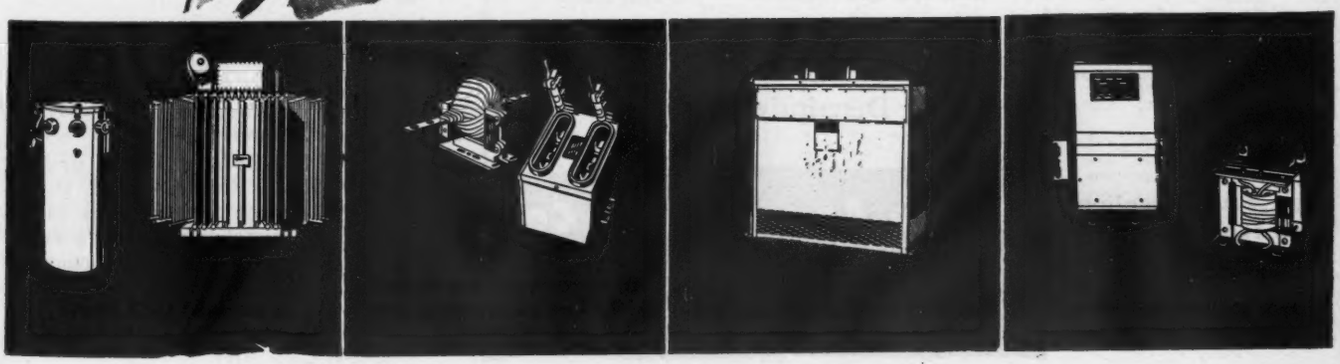

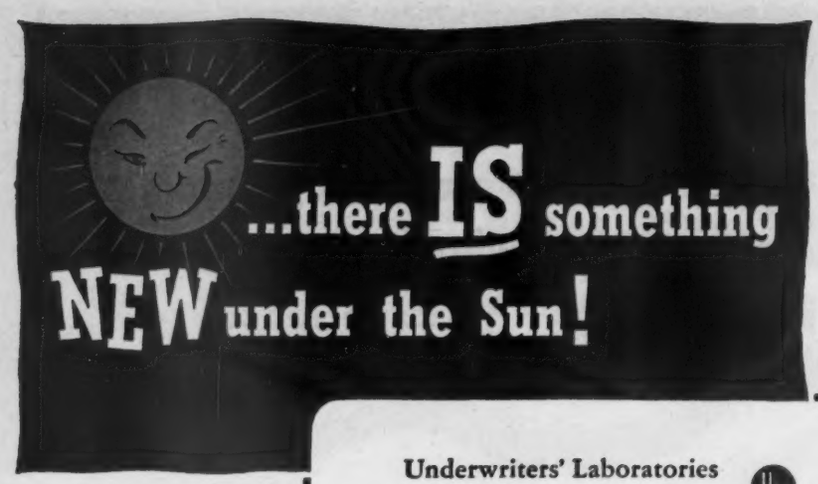

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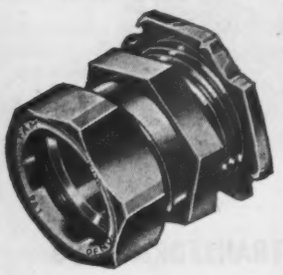

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that the insulation used was oil resistant. However, all thermoplastic compounds are softened when subjected to gasoline, so even Type TW will have a limited life. Recently a nylon jacketed conductor has been produced which seems capable of withstanding the solvent action of gasoline. This new conductor has been approved as an ordinary building wire and is being produced by the U. S. Rubber Company and the Anaconda Wire and Cable Company. This nylon jacketed conductor apparently is the best available material for such circuits.—G.R.

Official NEC Interpretations

Section 5143, Wiring and equipment near fuel storage tank vent pipe. Interpretation No. 304, issued July 16, 1948.

QUESTION: How does Section 5143 apply in the case of a vent-pipe from a fuel storage tank.

ANSWER: When in an outside location, the wiring and equipment on a pole standard should be as required for a Class I, Division II hazardous location (Article 500) if within 20 feet horizontally from the vent and if also below the five foot level above ground, unless the authority enforcing the Code specifies that the wiring and equipment must conform to the requirements for a Class I, Division I, hazardous location.

Section 5015, Seal fittings where required. Interpretation No. 305, issued July 16, 1948.

QUESTION: In the case of a run of conduit two inches or larger in size, connecting two terminal or junction boxes, when does subparagraph 2 of paragraph (a) of Section 5015 of the 1947 edition of the Code call for more than one seal?

ANSWER: A single seal is called for when its position would be not more than 18 inches from either enclosure. However, if the conduit run is of more than 36 inches in length two seals are called for each not more than 18 inches from the nearest enclosure.

Section 3717, Accessibility of junction boxes. Interpretation No. 306, issued July 22, 1948.

QUESTION: With reference to Section 3717, must a junction box when located in an attic be accessible from within the premises if an exterior opening to the attic "not guarded by elevation" is available?

ANSWER: No.

Section 5015, Type of fittings not considered as enclosures. Interpretation No. 307, issued July 16, 1948.

QUESTIONS: Are fittings similar to Types LBH, EKC, and ESC (C-H Company) which are inserted in a conduit system solely to simplify pulling-in of conductors and which contain no splices to be considered enclosures in view of subparagraph 2, paragraph a of Section 5015?

ANSWER: No

Industrial Electrification

ENGINEERING • INSTALLATION • MAINTENANCE

Oil Field Power Distribution—Part III

A discussion on planning, including cost data.

By W. C. Bloomquist
Industrial Power Division
General Electric Co.
Schenectady, N. Y.

Selection of Transformer-bank Rating. Tables 6 and 7 are handy references for directly selecting transformer-bank capacities.

The transformer and also the motor rating must be greater than that corresponding to the *average* pumping load to allow for the extra losses and heating due to the cyclic variation of a pumping-jack load.

Allowance was made in these tables for differences in power factor and efficiency for various types of motors and for the extra losses and heating for this type of service.

For estimating purposes, the transformer rating in kva. may be taken as equal to the motor horsepower rating. This is on the basis that the motor is correctly selected and fully loaded on a pumping cycle.

If capacitors have values as recommended in Table 1, (Part I) then the transformer rating in kva. may be taken as equal to 75 percent of the motor horsepower rating.

Transformer - voltage Regulation. Tables 8 and 9 show the percent voltage drop or regulation through a transformer bank. These data are based on representative transformer-impedance values and for load and power factor corresponding to a fully loaded motor for pumping service. At reduced motor load, the voltage regulation will be less than shown, even though the power factor is poorer.

These data are for one motor. The total voltage drop with more than one motor is directly proportional to the number of motors.

Table 10 shows the percent voltage drop or regulation through a transformer bank due to starting a motor.

Example of an Oil-Field Layout

Since the distribution-system layout is influenced by the voltage drop at the remote well locations, the first step

TABLE 6

APPROXIMATE REQUIRED TRANSFORMER-BANK KVA. RATING (without capacitors)

Motor(2) hp	Number of Motors Per Transformer															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
3	4.5	9	9	15	15	22.5	22.5	30*	30	30	30*	45*	45	45	45	45
5	9	15*	15	22.5	30*	30	45*	45	45	45	75	75	75	75	75	75
7.5	9	15	22.5	30	45*	45	75*	75	75	75	75	112.5	112.5	112.5	112.5	112.5
10	15*	22.5	30	45	45	75	75	75	112.5*	112.5	112.5	112.5	150	150	150	150
15	15	30	45	75	75	112.5*	112.5	112.5	150	150	150	225*	225*	225	225	225
20	22.5	45	75	75	112.5	112.5	150	150	225*	225	225	225	300	300	300	300
25	22.5	45	75	112.5	112.5	150	150	225*	225	225	300	300	300	300	300	450
30	30	75*	75	112.5	150	150	225*	225	225	300	300	300	450	450	450	450
40	45*	75	112.5	150	225*	225	300	300	300	450	450	450	450	600*	600	600
50	45	112.5*	150	225*	225	300	300	450	450	450	450	600	600	600		
60	75*	112.5	150	225	300	300	450	450	450	600	600					

(1) Transformer kva on basis of 3 single-phase transformers.
Those marked with (*) could use next smaller standard-size three-phase bank.
For estimating purposes, transformer kva = motor horsepower rating.

(2) Motors up to 20 hp — high-starting-torque type.
Motors above 20 hp — normal-starting-torque type.

TABLE 7

APPROXIMATE REQUIRED TRANSFORMER-BANK KVA. RATING (with capacitors)

Motor(2) hp	Number of Motors Per Transformer															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
3	4.5	4.5	9	9	15*	15	15	22.5	22.5	22.5	22.5	30	30	30	30	45*
5	4.5	9	15*	15	22.5	22.5	30	30	30	45*	45	45	45	45	75	75
7.5	9	15*	15	22.5	30	30	45	45	45	75*	75	75	75	75	75	112.5
10	9	15	22.5	30	45*	45	75	75	75	75	75	112.5*	112.5*	112.5	112.5	112.5
15	15*	22.5	30	45	75*	75	75	112.5*	112.5*	112.5	112.5	150	150	150	150	225*
20	15	30	45	75	75	112.5*	112.5	112.5	150	150	150	225*	225*	225	225	225
25	22.5	45*	75	75	112.5*	112.5	150	150	150	225*	225	225	225	300	300	300
30	22.5	45	75	112.5*	112.5	150	150	225*	225	225	300	300	300	300	300	450
40	30	75	112.5*	112.5	150	225*	225	225	300	300	300	450	450	450	450	450
50	45*	75	112.5	150	225*	225	300	300	300	450	450	450	450	450	600	600
60	45	112.5*	150	225*	225	300	300	450	450	450	450	600	600	600		

(1) Transformer kva on basis of 3 single-phase transformers.
Those marked with (*) could use next smaller standard-size three-phase bank.
For estimating purposes, transformer kva = 0.75 motor horsepower rating, based on power factor of 97.5 per cent, or with motors with capacitors listed in Table 1.

(2) Motors up to 20 hp — high-starting-torque type.
Motors above 20 hp — normal-starting-torque type.

TABLE 8

APPROXIMATE PERCENT VOLTAGE DROP THROUGH A TRANSFORMER BANK FOR ONE MOTOR RUNNING (WITHOUT CAPACITORS)

Motor hp	3-PHASE TRANSFORMER BANK KVA																			
	4.5	9	10	15	22.5	25	30	37.5	45	50	75	100	112.5	150	200	225	300	450	500	600
	SECTION I										SECTION III						SECTION V			
3	2.0	1.0	0.9	0.6	0.4	0.35	0.3	0.25	0.2	0.2										
5		1.5	1.4	0.9	0.6	0.55	0.45	0.35	0.3	0.28	0.18									
7.5		2.3	2.0	1.4	0.9	0.8	0.7	0.55	0.45	0.4	0.25	0.2	0.18							
10			2.7	1.8	1.2	1.1	0.9	0.7	0.6	0.55	0.35	0.25	0.23	0.18						
15					1.8	1.6	1.4	1.1	0.9	0.8	0.5	0.4	0.35	0.25	0.23	0.2				
20					2.4	2.2	1.8	1.4	1.2	1.1	0.7	0.5	0.5	0.35	0.3	0.25	0.2	0.13		
	SECTION II										SECTION IV						SECTION VI			
25						2.3	1.9	1.5	1.3	1.1	0.7	0.5	0.45	0.35	0.28	0.25	0.18	0.13		
30							2.3	1.6	1.5	1.4	0.8	0.6	0.55	0.4	0.35	0.3	0.23	0.15		
40									2.0	1.8	1.1	0.8	0.7	0.55	0.45	0.4	0.3	0.2		
50										2.3	1.4	1.0	0.9	0.7	0.55	0.5	0.35	0.25	0.23	0.18
60											1.6	1.2	1.1	0.8	0.7	0.6	0.45	0.3	0.28	0.23
75											2.0	1.5	1.4	1.0	0.8	0.8	0.55	0.35	0.35	0.28

NOTE

Table based on 1200 rpm motors.

Following multipliers for other motor speeds

Motor rpm	Sections I, III, and V	Sections II, IV, and VI
900	1.2	1.1
1800	0.9	1.0

Motors up to 20 hp — high-starting-torque type.

Motors above 20 hp — normal-starting torque type.

TABLE 9

APPROXIMATE PERCENT VOLTAGE DROP THROUGH A TRANSFORMER BANK FOR ONE MOTOR RUNNING (WITH CAPACITORS)

Motor hp	3-PHASE TRANSFORMER BANK KVA																			
	4.5	9	10	15	22.5	25	30	37.5	45	50	75	100	112.5	150	200	225	300	450	500	600
3	1.3	0.7	0.6	0.4	0.45	0.25	0.2	0.15	0.13	0.13										
5		1.0	0.9	0.6	0.4	0.35	0.3	0.25	0.2	0.18	0.1									
7.5		1.5	1.3	0.9	0.6	0.55	0.45	0.35	0.3	0.25	0.15	0.1	0.1							
10			1.8	1.2	0.8	0.7	0.6	0.45	0.4	0.35	0.18	0.15	0.13	0.1						
15					1.2	1.0	0.9	0.7	0.6	0.55	0.3	0.2	0.2	0.15	0.13	0.1				
20					2.6	1.4	1.2	0.9	0.8	0.7	0.4	0.3	0.25	0.2	0.15	0.15	0.1	0.07		
25						1.7	1.5	1.2	1.0	0.9	0.45	0.35	0.3	0.23	0.2	0.15	0.13	0.08		
30							1.7	1.2	1.2	1.0	0.55	0.4	0.35	0.28	0.2	0.2	0.15	0.1		
40									1.5	1.4	0.7	0.55	0.5	0.35	0.3	0.25	0.2	0.13		
50										1.7	0.9	0.7	0.6	0.45	0.35	0.3	0.25	0.15	0.15	0.13
60											1.1	0.8	0.7	0.55	0.45	0.4	0.3	0.2	0.18	0.15
75											1.4	1.0	.9	0.7	0.55	0.5	0.35	0.25	0.23	0.18

NOTE

Table based on approximately 97.5 per-cent power factor or with motors having capacitors as listed in Table I. Data applies to 900, 1200, and 1800-rpm motors.

Motors up to 20 hp — high-starting torque type.

Motors above 20 hp — normal-starting-torque type.

the remote well locations, the first step is to check the voltage drop.

The voltage drop in the primary line and the transformer, at the remote substation, usually ranges from 3 to 5 percent. As a starting point, assume this to be 4 percent and then determine the required conductor size to limit the voltage drop in the secondary lines to 10 to 12.5 percent. The voltage drop through the transformer bank can be quickly selected from the tables. Voltage-drop checks will have to be made for a few conductor sizes for the primary line. The total voltage drop at the remote well should not exceed 15 percent as discussed previously. Usually, some trial calculations for various conductor sizes are required, but with a little experience the proper conductor size can be determined quickly.

In order to illustrate the use of the various data, an example will be used. The following are the conditions:

1) Wells to be electrified, 54

2) Motors, 15 hp., 440 volts, 1200 rpm., high-starting torque type

3) All motors fully loaded and operated at 70 percent power factor

4) Well spacing, 1320 feet

5) Transformer rating to be selected on basis that all wells are pumped simultaneously.

6) Well locations as shown in Fig. 11, (Part II)

7) Primary-power source, 4160 volts.

Two cases are studied, one without use of capacitors and the other with capacitors for power-factor improvement. In each case conductor sizes were selected so the total voltage drop at remote well locations, W_1 and W_3, would not exceed 15 percent.

Case I. Distribution system without capacitors.

No. 1/0 ACSR for 4160-volt line

No. 1 ACSR for 440-volt line

Total voltage drop, including that in the primary and secondary lines and transformer bank, is 14 percent.

Case II. Distribution system with capacitors for power-factor improvement.

No. 2 ACSR for 4160-volt line

No. 2 ACSR for 440-volt line

Total voltage drop, including that in the primary and secondary lines and the transformer bank, is 12.3 percent. A smaller conductor could be used as far as voltage drop is concerned, but No. 2 ACSR is the minimum size for mechanical reasons.

Pole spacing for aluminum may range from 300 to 500 feet. Assume a spacing of 440 feet. The number of poles required can be determined as follows: (See Substation T6, Fig. 11). Starting from the substation toward well W2, three poles spaced 440 feet apart are necessary in the 1320-foot run. This includes a pole at well location W2. Three poles are required from W2 to W1. A similar procedure is followed for the remainder of the S poles. Do not include a pole at substation locations.

From T6 to W8, the poles carry both primary and secondary conductors. Three P and S poles are required from T6 to and including W8. From W8 toward T5, there is 1320 feet of primary line only. Only two P poles are required in this distance since

the next well requires a P and S pole and, therefore, takes care of the primary conductors. A similar procedure is followed for the rest of the lease.

The number of poles required is:

Pole Type	*Pole Spacing 440 Ft.*
S	111
P	10
P & S	33
M	54

Pole costs from Table II are:

111 — S poles at $60 each....	$6,660
10 — P poles at $70 each....	700
33 — P & S poles at $80 each	2,640
54 — M poles at $80 each....	4,320
	$14,320

Conductor Costs. Conductor costs are given in Table 12 and include the cost of stringing and sagging.

If the well spacing, 1320 feet, is taken as a unit length, the total conductor costs can be quickly obtained. The total number of unit lengths of secondary conductor is 48 and includes the secondary conductors on the P and S lines. The total for the primary is 16.

Conductor costs from Table 12 are:

Case I

48 unit lengths of No. 1 ACSR at $208..... 9,984

16 unit lengths of No. 1/0 ACSR at $240.....3,840

Total $13,824

Case II

64 unit lengths of No. 2 ACSR at $184.....$11,776

(Same conductor size used for primary and secondary.)

Substation Costs. The transformer-bank ratings are selected on the basis of nine 15-hp. motors per substation.

Case I

Required transformer bank rating, from Table 6, is 150 kva. Six 150-kva., 4160-volt substations, Table 13, at $1500 each — $9,000.

Case II

Required transformer-bank rating, from Table 7, is 112.5 kva. (Note that because the load power factor is improved, the required transformer-bank rating is much smaller than for Case I.) Six 112.5 kva., 4160 volt substations, from Table 13, at $1215 — $7,290.

Capacitor Costs. For Case II, the cost of capacitors must be added. From Table 1, for a 15-hp., 1200-rpm., high-starting torque-type motor, a 5-kvar capacitor is the maximum recommended. The cost of capacitors, from Table 14, is $12.50 per kvar, or $62.50 for 5 kvar. The total number of units

TABLE 10
TRANSFORMER-VOLTAGE REGULATION TABLE SHOWS PERCENT DROP OR REGULATION THROUGH A TRANSFORMER BANK DUE TO STARTING A MOTOR

Motor[2] hp	3-PHASE TRANSFORMER BANK KVA																			
	4.5	9	10	15	22.5	25	30	37.5	45	50	75	100	112.5	150	200	225	300	450	500	600
3	12.7	6.4	5.7	3.8	2.5	2.3	1.9	1.5	1.3	1.1	0.8									
5		9.7	8.8	5.9	3.9	3.5	2.9	2.3	2.0	1.8	1.3	1.0	0.8							
7.5		13.9	12.5	8.4	5.6	5.0	4.2	3.3	2.8	2.5	1.8	1.3	1.2	0.9						
10			16	10.7	7.5	6.4	5.4	4.3	3.6	3.2	2.3	1.7	1.5	1.1	1.0	0.9				
15				15.8	10.5	9.4	7.9	6.3	5.3	4.7	3.4	2.5	2.2	1.7	1.5	1.3	1.0			
20					13.7	12.3	10.3	8.2	6.9	6.2	4.4	3.3	2.9	2.2	1.9	1.7	1.3	0.9		
25						16.2	13.6	10.8	9.0	8.1	5.9	4.5	4.0	3.0	2.6	2.3	1.7	1.2	1.0	0.9
30							16	12.8	10.7	9.6	7.0	5.3	4.7	3.5	3.1	2.7	2.1	1.4	1.2	1.0
40									14.2	12.8	9.5	7.1	6.3	4.8	4.1	3.7	2.8	1.8	1.7	1.4
50										15.6	11.7	8.8	7.8	5.8	5.1	4.5	3.4	2.3	2.0	1.7
60											13.9	10.4	9.3	7.0	6.0	5.4	4.1	2.7	2.4	2.0
75											17.5	12.9	11.5	8.6	7.5	6.7	5.0	3.3	3.0	2.5

NOTE

(1) Voltage drop with capacitors connected to motor, approximately 5 per cent less than values in table.

(2) Motors up to 20 hp — high-starting-torque type. Motors above 20 hp — normal-starting-torque type.

TABLE 11
INSTALLED COST OF POLES

Pole Type[1]	Nominal System-Voltage Class		
	2400 or 4160	6900	11,000 to 13,200
P (Primary)	$ 70	$ 75	$ 85
P & S (Primary and Secondary Rack)	80	85	95
S (Secondary Rack)	60		
M[2] (Motor Well Connection)	80		

NOTES (1) See Figs. 4 through 7 for various types of poles

(2) Include an M pole for each motor.

TABLE 12
INSTALLED COST OF CONDUCTORS
COPPER CONDUCTORS

Wire Size	Approx. Current Capacity, Amps.	Conductor Wt. per Wire per 1000 ft., Pounds	Total Cost of Conductors and Stringing and Sagging per 1000 ft. per 3-phase Circuit, Dollars	Total Cost of Conductors and Stringing and Sagging per 3-phase Circuit				
				165 Ft Dollars	330 Ft Dollars	660 Ft Dollars	990 Ft Dollars	1320 Ft Dollars
2	209 amps.	203 lb.	$220	$ 36	$ 72	$144	$218	$288
1	244	259	262	43	86	172	258	344
1/0	283	326	314	52	104	208	311	416
2/0	335	411	381	63	126	252	378	504
3/0	389	518	465	77	154	308	462	616
4/0	446	653	600	99	198	396	594	692
250,000 CM	502	772	694	115	230	460	693	920

ALUMINUM CONDUCTORS (ACSR)

Wire Size	Copper Equivalent								
2	4	140	93	138	23	46	92	136	184
1	3	160	117	158	26	52	104	156	208
1/0	2	186	147	184	30	60	120	182	240
2/0	1	215	185	215	36	72	144	213	288
3/0	1/0	250	233	256	42	84	168	253	336
4/0	2/0	290	295	368	61	122	244	364	488
266,800 CM	3/0	389	358	420	69	138	276	414	552

(1) NOTE

Cost of copper taken as 26 cents per pound and aluminum at 28 cents per pound, includes overhead, etc. The cost of stringing and sagging taken as 2 cents per wire for sizes up to 3/0 and at 3 cents above 3/0. Cost basis 1944-1945, Southwestern area.

SCRU-ITS

U. S. Patent No. 1,933,555

SOLDERLESS
WIRE CONNECTORS
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TABLE 13
APPROXIMATE INSTALLED COST OF SUBSTATIONS

Substation 3 Phase KVA	Nominal System-Voltage Class: 2400 Volts — Transf. Costs(2)	2400 Volts — Installed Sub Cost(3)	4160 Volts — Transf. Costs	4160 Volts — Installed Sub Cost	6900 Volts — Transf. Cost	6900 Volts — Installed Sub Cost	11,000 to 13,200 Volts — Transf. Cost	11,000 to 13,200 Volts — Installed Sub Cost
4.5	$ 150	$ 300	$ 160	$ 310	$ 215	$ 380	$	$ ....
9	175	325	190	340	245	410	340	520
15	260	410	270	420	340	505	425	605
22.5	320	470	350	500	430	595	....	....
30	370	520	400	550	500	665	590	770
45	455	605	490	640	600	765	700	880
75	630	955	695	1020	800	1150	920	1295
112.5	815	1140	890	1215	1040	1390	1150	1525
150	990	1415	1075	1500	1230	1700	1360	1885
225	1340	1765	1415	1840	1620	2100	1740	2265
300	1650	2225	1745	2320	1920	2550	2040	2715
450	2265	2840	2370	2950	2520	3150	2600	3275
600	2820	3400	2900	3475	3020	3650	3050	3725

NOTES

(1) Based on transformer bank consisting of three single-phase transformers. For 3-phase transformer use above transformer costs for estimating, and adjust installation as necessary.

(2) Transformer costs include lightning arresters and cutouts. Transformer banks connected for *delta-delta*. Lightning arresters for ungrounded service. Transformers below 5 kv with pocket bushings and above 5 kv with two cover bushings. Transformers with taps for a total range of 10 per cent.

(3) Installed substation cost includes transformers, arresters, and cutouts, material for structure, labor of installation, and overhead.
All costs for 1944-1945 period in Southwestern area.

TABLE 14
APPROXIMATE INSTALLED COST OF 460-VOLT CAPACITORS
(Cost Basis 1944-1945)

INDIVIDUAL CAPACITORS FOR MOTORS

Rating	Dollars per Kilovar: Cost	Installed Cost
5 kvar	$10.00	$12.50
Above 5 kvar	7.50	9.00

These are totally enclosed units, weathertight, for outdoor service and include individual fuses.

GROUP CAPACITOR BANKS

Rating	Dollars per Kilovar: Cost	Installed Cost
60 kvar	$9.50	$11.00
90 kvar	8.50	9.75
120 kvar	8.50	9.75
180 kvar	8.00	9.25

These are totally enclosed capacitor equipments for outdoor service and include individual fuses for each capacitor and a manually operated main disconnecting switch.

required is fifty-four, 5-kvar capacitors at $62.50 each, or $3,375.

The following is a summary of the total cost of the power distribution system for the two methods:

Costs	*Case I Without Capacitors*	*Case II With Capacitors*
Poles	$14,320	$14,320
Conductors ..	13,824	11,776
Substations ..	9,000	7,290
Capacitors ...	.....	3,375
Total	$37,144	$36,761
Add 10 percent for misc. ...	3,714	3,676
Total cost	$40,858	$40,437
Estimated cost per well ...	$ 755	$ 750

Although the initial investment for the two methods are comparable for this lease layout, that isn't the complete story; there is also an attractive saving in system losses due to capacitors. This saving in losses, including primary and secondary lines and transformers is approximately 16 kilowatts. If power costs one cent per kilowatt-hour, then the annual savings in energy losses are: $16 \times 8760 \times \$0.01 = \$1402$. This corresponds to an annual gross rate of return on the capacitor investment of 38 percent.

If the usual type of power-factor clause is included in the rate structure, there will be an additional annual saving which is generally in the order of 50 to 200 percent of the capacitor investment.

It is apparent that capacitors are economically attractive since they pay for themselves through savings in system losses alone in slightly less than two and one-half years. For this reason they are finding increasing acceptance in oil field distribution systems.

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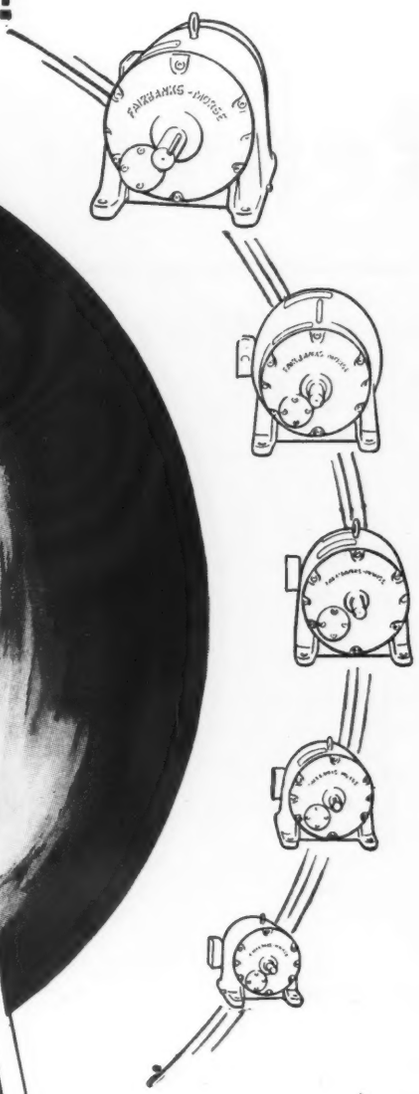

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Reader's Quiz

Motor on Oil Burner

QUESTION 293—I have a ¼ hp. capacitor start motor which drives the blower on a domestic oil burning furnace. The owner complains of a dull thudding noise as this motor comes to a stop. After examination, I decided this was due to the charge held by the capacitor discharging through the windings as the starting switch closed, and tried to remedy it by soldering a 50,000 ohm carbon resistor directly across the terminals of the capacitor to discharge it. However, as this did not improve the situation, what could cause this noise and how can it be remedied? Nearly the same sound is observed with the belt removed. —J.H.N.

A. TO QUESTION 293—The description of the noise as a dull thud indicates that the probable cause of trouble is some part of the rotor striking some stationary part of the motor. The motor should be taken apart and a careful examination made to find any rubbing surfaces. The fact that this noise occurs only when the motor is stopping could be caused by the rotor being in one axial or longitudinal position with the current on and in another position with the current off, due to the magnetic field.—C.P.S.

A. TO QUESTION 293—In this capacitor start motor used on said oil burner, it is quite possible that the noise heard as the motor comes to a stop is caused by the starting winding switch.

Most manufacturers of these single phase motors have used a type of centrifugal switch to have the starting winding cut out once the motor gets up to running speed. Now if the working of this switch is retarded due to dirt or rust, the snap action is going to be delayed, and may not occur until the motor is practically stopped. Naturally, the noise of the switch reclosing is going to be most noticeable if it is delayed by any defect or improper adjustment until the motor has stopped completely. The noise at closing could also be aggravated by the combination of a sticking condition in the open position and a stiff spring on the centrifugal switch.

The remedy will require that the motor be inspected for possible faults as outlined in the preceding paragraph, as well as to see that the spring tension in the centrifugal switch is correct.—E.E.

A. TO QUESTION 293 — The dull thudding noise created as your motor comes to a stop is probably caused by mechanical trouble rather than electrical trouble. It may be caused by the bearings or by a binding centrifugal starting mechanism. Bearings out of alignment, caused by dirt or foreign matter in the joint between motor frame and end plate. This will cause a binding in the bearings, which will tend to make them hot, therefore making the shaft stick as it nears a stop.

Many times when new sleeve bearings are installed and are a little tight, it will cause the motor to make a dull thud when it stops, especially in larger motors.

From my experience it would seem that your trouble lies in the bearings, either that they are too tight or they are binding from improper alignment.

You might also check for a faulty pump or binding universal joint if it is connected this way to the motor.—R.D.R.

A. TO QUESTION 293—In the case of the capacitor start motor which causes a thudding sound as it comes to a stop, would advise that the rotating governor parts be closely examined.

One type of governor has felt wear pads that contact the stationary switch during starting and stopping periods. Sometimes these pads become glazed so that a very noticeable "flutter" is caused when the motor is coming to a stop, but isn't evident while starting because of the speed of the throwout. Either replacing or re-aligning the parts, or often a small amount of lubricant, will effect a cure. On other types of rotating governors, felt or rubber bumpers on the weights may be worn out, or gone, which would cause a decided thump, thud, or click when the weights fly closed.

Sometimes a motor rotor will shift end wise if the endplay is excessive, as it is coming to a stop, causing a thud when the shoulder on the shaft strikes, or if very excessive, the fan could be striking an end felt.

As a check on the condenser, it can be "dead shorted" before the motor comes to a stop, to determine if this is the cause of the noise. The starting winding itself would be an effective discharge resistance, if the condenser held any charge until the motor completed its duty cycle and came to a stop. Any other electrostatic discharge could probably be stopped by ground jumpers around the rubber mounts.

Most of these sounds will hardly be evident or objectionable in a motor on the bench, but when it becomes a part of a heating system, the sounding board effect of sheet metal housings, and the natural amplifying properties of heating ducts, cause them to be very annoying.—C.E.F.

Testing Tubes

QUESTION 294—Have any of your readers had any experience in testing out tubes in industrial electronic control circuits with a neon lamp? If so, what is the proper procedure?—E.J.K.

A. TO QUESTION 294 — We tried a neon tester but found it not very desirable in testing out tubes in electronic control circuits. Modern electronic tubes rarely fail suddenly. Failure usually follows the gradual loss of emission that takes place as the active cathode material is used up or flakes off. Any incorrect operation or loss of emission cannot be measured to any accurate degree with a neon lamp. A more satisfactory way to test indus-

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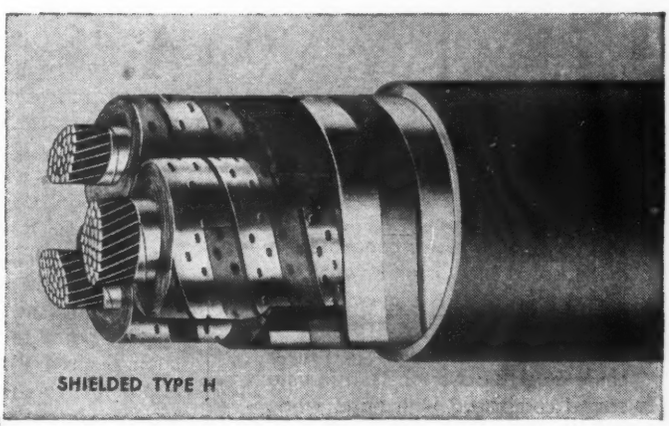

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trial electronic control circuits is to use some of these instruments and devices I have described in the following paragraphs.

Since many circuits on electronic panels have a very high impedance, meters having high impedance are very desirable in servicing the equipment. A useful tool is the radio service multimeter which has a resistance of 1000 ohms per volt or higher. For some circuits, however, an electronic meter, such as a vacuum-tube voltmeter of the dc reading type or a cathode-ray oscilloscope, is essential.

The cathode-ray oscilloscope, particularly when modified to read direct-current potentials, is an extremely useful device since it combines a very high impedance voltmeter with a time axis, thus making visible voltage changes much too rapidly for the ordinary meter to follow. Instantaneous thyratron grid and plate potentials and other voltage waveforms may be observed easily on the oscilloscope and any incorrect operation quickly detected. These meter tests have been found to give much more efficient and satisfactory operating results than a neon tester.—R.D.R.

Rewound Motor

QUESTION 295 — Could you explain why a single phase repulsion induction motor does not change direction? This motor has been rewound. And although we shifted the brush holder as far as possible, it still does not change direction.—F.L.

A. TO QUESTION 295—Since this repulsion induction motor has been rewound, the reason it cannot be reversed by shifting the brushes is very likely due to the fact that instead of the new stator coils being rewound in the original slots, they were misplaced by 2 or 3 slots either to the right or left of the original position. Thus, instead of being able to shift the brushes from one side of the neutral point to the other, depending upon desired direction of rotation, it is possible to shift them through their range only on one side of the neutral point, therefore, the direction of rotation is not changed, and the only result obtained is a varying degree of starting torque.

To remedy the situation, it will be necessary to remove the bolt or screw locking the brush holder in position, shift the brushes and temporarily hold them in different positions, while jogging the motor, until a neutral point is found. When this point is found, it should be carefully marked, and some permanent means provided to relocate the locking screw so that a brush travel either side of this point can be obtained, corresponding to that of the original setting.

If the construction of the motor was such that the stator coil was pressed out of the frame for rewinding, it is a possibility that it was not pressed back in the same "tracks," or else was turned wrong end to, which in most motors would also cause a coil displacement in relation to the brushes. In this event, it might be easier to press out the stator and replace it properly, than it would be to attempt to relocate the brush holder.—C.E.F.

A. TO QUESTION 295 — The neutral position of the motor depends upon the armature winding and the field winding. When this motor was rewound, the winding may have been put on in such a way as to change neutral position. Therefore, when the brushes are shifted a few degrees, they do not pass through the neutral position and do not reverse the motor.—C.P.S.

A. TO QUESTION 295—A good possibility for this repulsion induction motor refusing to change direction would be that in the rewinding process either the stator coils were displaced from their original slots, or the armature coils were not connected to the original commutator bars. Either condition could result in displacing the brush neutral position to such an extent that the brushes cannot be shifted through neutral.

It is probable that the only possible remedy is to rewind the motor again to the original specifications, although on some makes of motors it might be possible to alter the mechanical arrangement of the rocker arm so that the brushes can be moved far enough against the present direction of rotation to reverse the motor.

One other slight possibility as to the cause of the trouble in the case of a 2, 6, or 10 pole motor would be that the end bell containing the rocker arm has been shifted 90 degrees from its proper position, assuming the usual 4 bolt mounting of the end bells. This condition should not effect the operation of a 4 or 8 pole motor.—W.B.S.

A. TO QUESTION 295 — One should be able to reverse any of the three (3) single phase repulsion motors by shifting the brushes, that is the repulsion start, repulsion and repulsion induction motors. By noting where the neutral setting of the brushes is (in this position there will be no rotation and is marked by manufacturer) and then moving the brush rig-

In the News

Procedure in Jurisdictional Disputes

The National Joint Board for the settlement of jurisdictional disputes has taken steps to perfect its procedures so as to insure against work stoppages which have occurred in the construction industry despite the new AFL-contractor agreement for preventing them.

Shortly after the first two decisions were issued in August, the nine-man Board of Trustees adopted this three-point statement for the guidance of contractors:

1. Where a jurisdictional agreement or AFL decision of record applies to the situation, assign the work accordingly.
2. Where none applies, assign the work according to the established practice in the local area. (If a union disagrees with your judgment, it can appeal to the Joint Board.)
3. Do not postpone work while waiting for a decision from the Joint Board.

The Board of Trustees, in its preliminary remarks, said it had received complaints of work stoppages in violation of the union-industry agreement.

Two decisions have been issued by Joint Boards, both unanimous. The first clarified the jurisdiction of the plumbers and sheet metal workers on installation of copper fittings and coils in beer vats. The second resolved differences between the sheet metal and iron workers over installation of steel decking, but also clarified the rights of the IBEW.

Whenever steel decking for flooring or roofing is used as a raceway for electrical wiring, the electrical work in connection with the raceway is that of the IBEW, the decision said.

The second decision does not alter two other decisions of record, including that of May 19, 1947, giving iron workers erection of Q-panels when fastened to the steel structure of a building, but leaving to the sheet metal workers any flashing or ventilator work involved.

Each decision covered two disputes, one brought to the Joint Board by a contractor and one by a union. Turner Construction Company filed one of the brewery disputes from a job at Ballantine's Brewery in Newark, N. J. One of the steel decking disputes was filed by H. K. Ferguson Company from a job at Decatur, Illinois.

A third decision will decide a dispute between the plumbers and electricians over pre-heating and stress-relieving of welds on high-pressure pipe.

Hearings were set for early October on three other jurisdictional issues. They involve (1) the operation of gasoline driven electric generators for welding, (2) the application of aluminum shingles and (3) the stripping of forms from concrete.

More than 2,000 contractors have signed stipulations agreeing to be bound by the new plan, which went into operation May 1. Although it is the product of an agreement between the AFL Building Trades Dept., the Associated General Contractors and seven specialty contractors, it may be utilized by any contractor employing AFL Building Trades workers if he signs a stipulation.

NEW OFFICERS of the Chicago Section, Illuminating Engineering Society are: (L to R) Vice-chairman—Ralph R. Cheney, Westinghouse Lamp Division; chairman—Glenn G. Boyd, Public Service Company of Northern Illinois; retiring chairman—Charles E. Johnson, Curtis Lighting, Inc., secretary, Clarence B. Pederson, Illinois Bell Telephone Company. Here, Mr. Johnson, who continues as a member of the Board of Managers, receives as a personal gift from the Section, the gavel presented to him when he took office a year ago.

Fisher Heads IAEI

Jack G. Fisher, Superintendent, Electrical Department, Mississippi State Rating Bureau, Jackson, Miss., was recently elected president of the International Association of Electrical Inspectors.

A native of Paducah, Kentucky, Mr. Fisher graduated from the elementary schools and St. Marys Academy; supplemented his education with an ICS electrical course and began his electrician's apprenticeship in Paducah. After completing it in St. Louis, Mo., he worked at the trade for a number of years in various cities in the central and Northern states.

He spent five years as an electrical inspector in Kentucky, then worked at the trade during World War I in Washington, D. C. doing plant and substation construction. From the close of that war until 1924, he was chief electrician of the State, War and Navy Department buildings in Washington. He resigned that assignment in 1924 to take his present position.

Mr. Fisher joined the Western Section, IAEI in 1913 while with the Kentucky Actuarial Bureau in Lexington; helped organize the Southern Section and served as its president in 1935. He served on the Electrical Committee for twenty years; was on a number of Article Committees and was an Alternate from the IAEI and Stock Fire Insurance Bureau when the Electrical Committee was disbanded. He has also been a member of the IAEI Executive Council for a number of years.

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C. F. Crowder, Vice President of the H. N. Crowder Jr. Company of Allentown, Pennsylvania, discusses the organizational structure of the Crowder service and sales departments with Robert Brokloff, a Junior student in the Allentown High School. Bob Brokloff spent an entire week in the Crowder organization as part of a well-planned vocational guidance and electrical orientation program jointly designed by the high school electrical department and Crowder.

Perry Heads Chicago EME

W. A. Perry, Inland Steel Company, was recently elected president of the Electrical Maintenance Engineers of Chicago. Other officers elected at the Executive Committee meeting were: Vice-president—James E. Clark, Carnegie-Illinois Steel Corporation; secretary-treasurer, ex-officio—C. G. Franks of the Electric Association.

Tucker Manager of Minnesota Group

Gordon Tucker of Minneapolis was recently appointed manager of the Midwest Electrical Council, Inc., with headquarters in Minneapolis. He fills the vacancy caused by the resignation of former manager John Julsrud.

Following high school and university graduation, Mr. Tucker enjoyed a varied and successful business career. Following early experience in sales and the construction field, he was a Naval aviator in World War I; then gained additional experience as bond salesman, secretary of a manufacturing concern, inventor, sales manager and manufacturer. Before he enlisted for his second hitch in the Navy in 1942, he was back in the investment field in a managerial capacity.

During the war he was Executive and Assistant Executive Officer at two Naval headquarters; had overseas duty as Commanding Officer of Combat Aircraft Service Units in the Pacific; now holds the rank of Commander, U.S.N.R.

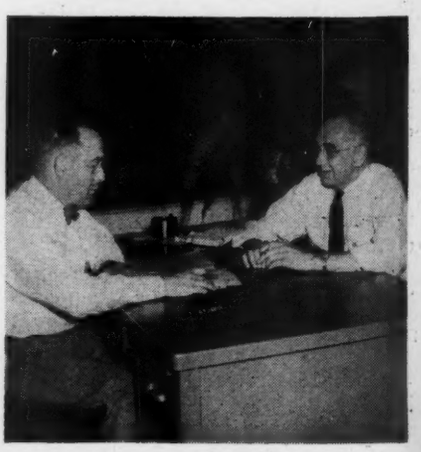
After his discharge from service, he spent two years as Chief of the Sales Planning and Control Division of War Assets Administration. Previous to his appointment as Council Manager, he was sales manager for a special equipment manufacturer.

Joint Entries Popular in Merit Award Competition

There is a trend toward more joint entries in the Merit Award Competition of the Third International Lighting Exposition sponsored by the Industrial and Commercial Lighting Equipment Section of the National Electrical Manufacturers Association, according to the Competition Committee.

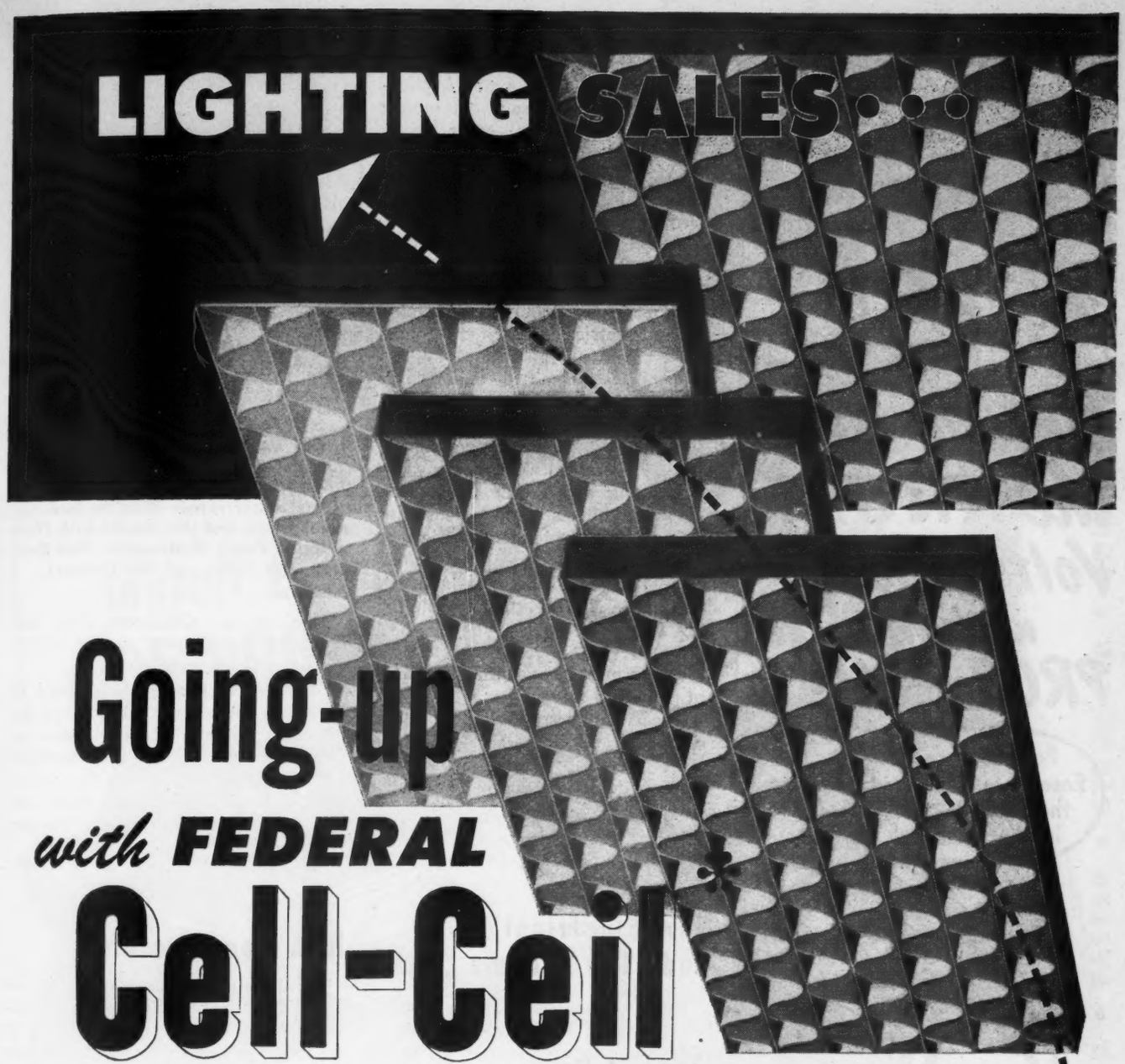
In the words of R. D. Bradley, Chairman of the Merit Award Committee, "The growing popularity of joint entries offers further evidence that a good job of Planned Lighting is generally not merely the work of one individual but may require as many "credit mentions" as a feature movie production. For example, it may be the joint work of an electrical contractor working with an electrical wholesaler and the lighting representative of a utilities company. The Competition Rules encourage the joint entry of all those who had an active part in producing the job.

The first step for those who wish to enter the Competition is to address a request for Official Rules Booklet to the Merit Award Committee, 326 West



Future plans and daily management problems are discussed and resolved across this desk in early morning conferences between Herb F. Janick (left) and Ray F. Hornbeck, President, T. H. Green Electric Co. Inc., electrical contractors and motor repairmen of Rochester, New York.

LIGHTING SALES . . .



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Madison Street, Room 818, Chicago 6, Illinois. The back page of this Booklet includes the Official Entry Application. This may be made out in one name, as an individual entry, or in two or three names representing a joint entry.

When this Application Blank is received by the Merit Award Committee, a Registration Card is issued, containing a Registration Number which must be affixed to each entry. A Contestant may submit not more than three case study entries and each entry must have a separate Registration Number. Case studies submitted must cover Planned Lighting Installations completed in 1948.

The full list of the groups eligible includes: Electrical Contractors; Utility Lighting and Power Representatives; Architects and Consulting Engineers; Wholesalers' Lighting Specialists and Salesmen and the new group Owners and Users of Industrial and Commercial Lighting, eligible this year, for the first time.

A new rule this year stipulates that all entries must be submitted on standard mounting board, 24 x 36", suitable for wall hanging. Winning Merit Award entries will be displayed at the Third International Lighting Exposition and Conference to be held at the Stevens Hotel, Chicago, March 29 through April 1, 1949.

George J. Hill, president of the R. S. Graves Company, Springfield, Massachusetts (right—with Popsicle) is lured from the comparative coolness of his motor repair shop to face the summer sun and the camera with (left to right) Frank Mastrangelo, Phil Beninati, Ray Nolan and Bill Connors.

Don Snyder, Oklahoma City, will represent the Chapter on the NECA Board of Governors.

Members of the Chapter Board of Directors include the officers and the following: Stanley Hirsch, Oklahoma City; Beverly Greenwood, Buffalo; Clarence W. Braker, Ponca City; Kenneth Gillespie, Shawnee; Ron Stephens, Lawton; and Ernest Tanner, El Reno.

New Electrical Code for Tacoma

The Tacoma, Wash., City Council has adopted a new electrical code to replace one in effect almost 20 years. The code, which had been under consideration by a committee sponsored by the Chamber of Commerce and headed by Walter S. Gordon, regulates the sale, lease, rental, installation, repair, use and removal of electrical wiring, equipment and appliances, according to Public Utilities Commissioner C. A. Erdahl.

Wear Heads Western Oklahoma Contractors

Ben L. Wear of Oklahoma City was elected president of the Western Oklahoma Chapter, NECA, at a recent annual meeting of that group. Other officers elected for the 1948-1949 term include: Vice-president — Fred H. Spaulding, Oklahoma City; treasurer —James R. McEldowney, Oklahoma City. Bill Damon is manager of the Chapter.

REA Construction

With half a billion dollars in its loan kitty, Rural Electrification Administration started out on July 1 to set new lending and construction records in fiscal 1949. The agency's announced goal was financing of construction of 120,000 miles of power distribution lines to be energized before next July 1. Additional lines will be under construction.

Money-wise and construction-wise, REA hopes to best records established in fiscal 1948. During that period the lending agency approved loans totalling $313,008,860, bringing the cumulative total of its loans to $1,381,513,377. Borrowers energized some 112,000 miles of lines and connected 396,000 new consumers, according to preliminary estimates of the year's activities.

Though still talking about "growing shortages of power" in rural areas, REA officials insisted they were not contemplating any significant increase in loan grants for construction of generating facilities. Increased capacity of existing lines and substations represent the greatest present need of REA-financed systems, they indicated.

Install E. M. T. Faster and Neater with BRIEGEL Thin-Wall Fittings

NEATER • FASTER • STRONGER • APPROVED

All B-M Fittings Carry the Underwriters' Seal of Approval

FOR faster, neater and stronger thin wall conduit connections insist on either Briegel Indenter or Briegel Twiston Self-threading type all steel, one piece connectors and couplings.

B-M Indenter fittings, the only approved couplings and connectors of this type, have long enjoyed wider use and application than any other method of installing E.M.T.

The new B-M Twiston Self-threading fittings now make it possible to have threaded, raintight E.M.T. connections without the use of dies. Two complete turns with a pair of pliers threads the tubing and screws the fittings into a locked position, which results in the strongest connection possible and one that will withstand severe vibration.

What ever the thin wall job might be, you will find that you can do it neater, faster and better with Briegel UL Approved E.M.T. fittings.

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GALVA, ILLINOIS

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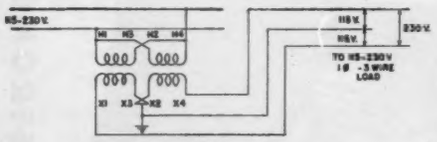
Clayton Mark & Co., Evanston, Ill. *Gen. Electric Co., Bridgeport, Conn.* *Enameled Metals, Pittsburgh, Penn.* *Kondu Mfg. Co., Ltd., Preston, Ontario*

HOW TO PROVIDE A 3 WIRE 115/230 VOLT CIRCUIT FROM A 2-WIRE PRIMARY

No need to rewire a job when you need a 3-wire 115/230 volt circuit. Simply connect an Acme Electric air cooled power transformer to the 2-wire primary at the most convenient location and you're all set for 3-wire 115/230 volt service.



Acme Electric air cooled transformers are available for immediate delivery in capacities from 1/10 KVA to 50 KVA in all standard primary voltage ratings up to 2400 volts. Write for Bulletin.

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Manufacturers of Transformers for Fluorescent lighting, radio and television, neon signs, electronic devices and rectifiers.

Acme Electric TRANSFORMERS

Administrator Claude R. Wickard estimated that more than 65 percent of American farms now have electric service, but "there are more than 2,000,000 unserved farms and several hundred thousand other rural establishments still without service." REA borrowers are operating 658,000 miles of line serving 2,240,000 consumers, he reported.

The agency also has completed its annual report of energy purchased by REA borrowers. The document, a year late in its preparation, covers the fiscal year ended June 30, 1947. It shows that REA systems purchased a total of 3,082,267,051 kwh. at a total cost of $26,909,545. The average cost per kwh. amounted to 8.7 mills, as compared with an average cost of 8.8 mills per kwh. in fiscal 1946.

Construction Contracts

Building and construction contracts awarded in the 37 states east of the Rocky Mountains neared the billion-dollar mark in July to set the cumulative investment commitment volume for this year through July at a point 38 percent higher than that reported for the first seven months of last year.

F. W. Dodge Corporation, a fact-finding organization for the construction industry, revealed that the total of contracts in July in the states east of the Rockies, as based on its field reports, amounted to $962,685,000. This total was 46 percent higher than the total for June of this year.

The sharp gains were reflected in all major classifications of construction, with nonresidential volume up 56 percent over July of last year and 8 percent over June, residential up 45 percent over July of last year and down 2 per cent from June, and heavy engineering works up 31 percent over July of last year and 1 percent over June.

Gains ranging from 15 percent in Minnesota and the Dakotas to 123 percent in New England were reported for all its reporting districts by the Dodge corporation in July over the corresponding month of last year, with exception of the region comprised of western Missouri, Kansas, Nebraska, and Oklahoma where a decline of 65 percent was shown.

On a cumulative basis, all 15 regions showed an increase for the first seven months of the year compared with the corresponding period of last year. The upstate New York district led this advance with a gain of 72 percent followed by the midwestern area of northern Illinois, Indiana, Iowa, Wisconsin and northern Michigan with a gain of 60 percent.

New England: Contract commitments in July totaled $89,572,000, a gain of 123 percent over the corresponding month of last year, and 58 percent over June of this year. The cumulative gain in contracts for the first seven months was 29 percent. Last month, nonresidential contracts were 54 percent higher than in July last year, but the total was down 5 percent from June. Residential awards last month were up 96 percent over July of last year and 45 percent over June. Phenomenal gains were reported in heavy engineering awards, last month's total being eight times greater than in July last year and four times greater than June's awards.

Metropolitan New York and Northern New Jersey: Although last month's award total of $111,528,000 was off 13 percent from the total for June, the volume was 103 percent higher than that reported for July of last year. Last month's volume brought the cumulative total for the first seven months to $674,436,000 or 38 percent higher than that reported for the corresponding period of last year. Nonresidential awards last month were 159 percent higher than the total reported for July last year and 22 percent higher than June's total. Residential awards showed a 66 percent gain over July 1947, but were down 24 percent from the June total. Heavy engineering awards were 167 percent higher than in July last year, and down 23 percent from the total for June.

Upstate New York: A 41 percent gain in July over the corresponding month of last year and a 36 percent gain over the total shown for June is reflected in the upstate New York volume of $35,621,000 reported for last month. The cumulative volume of building contracts for the first seven months of this year was 72 percent greater than that reported for the corresponding period of 1947. Nonresidential volume last month was 35 percent greater than in July a year ago and 72 percent higher than in June of this year. Residential awards in July showed a 61 percent increase over the corresponding month of 1947 but were down 3 percent from the June total. Heavy engineering construction showed an increase of 39 percent over July of last year and a 21 percent gain over June of this year.

Middle Atlantic States: Contracts awarded for building and construction in this area last month totaled $124,760,000 reflecting a 54 percent gain over July 1947 and a 15 percent increase over June of this year. Last month's heavy volume brought the cumulative record for this region to a level 37 percent higher than that re-

2 NEW AUSTIN STEEL CHANNEL BOX HANGERS!

Nail between joists - Eliminate Notching

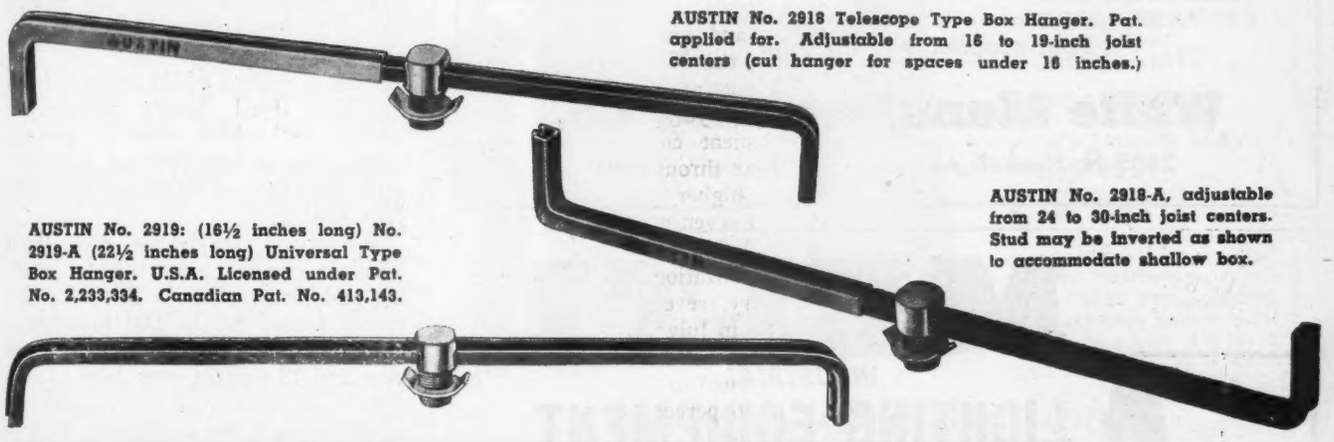
USE AS STRAIGHT SHALLOW OFFSET OR DEEP OFFSET BOX HANGERS

One Instead of Three — Perfect Alignment — Stronger, Lighter, Easier to Handle!

Because these new AUSTIN Box Hangers are nailed between the joists at any desired height they can be used as Straight Shallow Offset or Deep Offset Box Hangers.

No notching of joists is required as with the old conventional types to keep from bending, warping, or cracking surfacing material.

The steel channel (see cross-section illustration) provides greater strength and rigidity yet is much lighter in weight and therefore easier to handle.



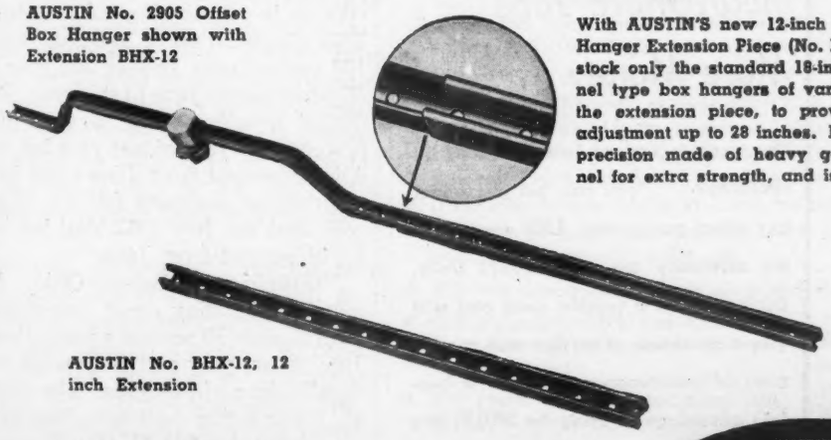
AUSTIN No. 2918 Telescope Type Box Hanger. Pat. applied for. Adjustable from 16 to 19-inch joist centers (cut hanger for spaces under 16 inches.)

AUSTIN No. 2919: (16½ inches long) No. 2919-A (22½ inches long) Universal Type Box Hanger. U.S.A. Licensed under Pat. No. 2,233,334. Canadian Pat. No. 413,143.

AUSTIN No. 2918-A, adjustable from 24 to 30-inch joist centers. Stud may be inverted as shown to accommodate shallow box.

KEEP BOX HANGER INVENTORIES LOW WITH AUSTIN'S NEW SLEEVE EXTENSION PIECE!

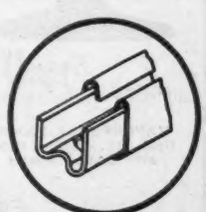
AUSTIN No. 2905 Offset Box Hanger shown with Extension BHX-12



With AUSTIN'S new 12-inch Sleeve Type Box Hanger Extension Piece (No. BHX-12) you need stock only the standard 18-inch AUSTIN channel type box hangers of various designs and the extension piece, to provide a maximum adjustment up to 28 inches. Extension piece is precision made of heavy gauge steel channel for extra strength, and is light in weight.

AUSTIN No. BHX-12, 12 inch Extension

Cross-section view of Steel Channel Box Hanger with Extension Piece.



Sketch illustrating how Extension Piece slides over Box Hanger end.

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It is a pleasure to tighten locknut and bushings on conduit and steel tube jobs with L.G.W. Angle Locknut Pliers.

No more skinned knuckles.

No more damaged screw drivers.

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Better Lighting Units mean More Jobs . . . More Money . . . . . .

The trend is toward better looking installations . . . you can get just about any effect you please AND good lighting efficiency too with MULTI Units. Each unit has a specific need and will give a maximum of service with a minimum of maintenance. There's a two-fold advantage in using the MULTI line —good looks—good pay!

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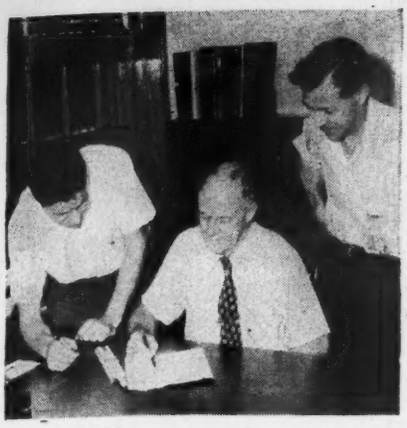
ported for the corresponding seven months of last year. Nonresidential construction in July was up 68 percent over July a year ago and 38 percent higher than in June. Residential contracts showed a substantial upsurge last month with a total 78 percent greater than in July a year ago and 47 percent higher than in June. Heavy engineering awards in July were maintained at the same level as shown for July of last year but were down 38 percent from the June awards.

Southeastern States: Contracts awarded in this region last month totaled $96,893,000. This volume was 23 percent greater than that reported for July of last year but was down 30 percent from the total awards for June. The cumulative total for the first seven months of the year was maintained at a level 41 percent higher than that reported for the corresponding period of last year. Nonresidential construction contracts in July were 23 percent greater than in July of last year but were down 1 percent from the June total. Residential awards last month were 3 percent greater than in the corresponding month of last year but showed a decline of 34 percent from the June level. Heavy engineering awards last month were 69 percent higher than in July 1947 but showed a precipitate drop of 50 percent from the June total.

Western Pennsylvania and West Virginia: Contracts awarded for building and construction in this area last month totaled $29,137,000 to show a gain of 30 percent over July of last year and 18 percent over June of this year. The substantial gains made last month brought the cumulative total to a point 31 percent greater than that shown for the corresponding seven months of last year. Last month's volume was maintained at a high level principally because of a substantial increase in non-residential contracts. This classification of building was up 108 percent over July of last year and 36 percent over June of this year. Residential awards showed a gain of 44 percent over July of last year but were down 3 percent from June while heavy engineering contracts fell off 56 percent from the July 1947 total but were up 14 percent from June.

Northern and Eastern Ohio: Last month's building and construction awards were 50 percent greater than in July of last year and 18 percent more than in June of this year. The total of all construction contracts last month was reported at $65,227,000. The cumulative total for the first seven months of this year was 32 percent higher than in the corresponding period of last year. Nonresidential awards in July were double the volume reported for the corresponding month of last year



Fred M. Shaw, president of Alfred L. Brown Associates, Inc., of Worcester, Massachusetts, checks over latest quotations on copper wire and V-belts with vice presidents Robert H. Brown and Robert A. Shaw.

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and were up 40 percent over the June total. Residential awards were up 15 percent last month over the corresponding month of last year and were maintained at the June level this year, while heavy engineering contracts fell off 18 percent from July a year ago and were down 20 percent from June of this year.

Southwestern Ohio and Kentucky: After trailing most other areas east of the Rocky Mountains in the first six months of this year, southwestern Ohio and Kentucky showed substantial recovery in July with a total volume of $33,031,000. This total was 49 percent higher than that reported for July of last year and 36 percent greater than that shown for June of this year. The cumulative total for the first seven months of the year was 4 percent greater than that reported for the corresponding months of last year. Nonresidential awards in July showed a 32 percent gain over the corresponding month of the previous year and a 5 percent gain over June. Residential awards were up 43 percent last month over July 1947 and were up 33 percent over June of this year. Heavy engineering awards in July were 88 percent greater than in July of last year and 116 percent higher than in June this year.

Southern Michigan: Investment commitments for new construction in southern Michigan last month totaled $52,658,000 to show a gain of 40 percent over July 1947 and a 10 percent increase over June of this year. The cumulative record for the first seven months of this year was 33 percent higher than that reported for the corresponding period of last year. In July nonresidential awards increased 106 percent over July of last year and 35 percent over June. Residential awards showed a 12 percent increase

GREAT NEWS *for Electrical Contractors, Maintenance Men, Motor Repairmen, Appliance Men, etc.*

THE NEW MODEL 40

UTILITY TESTER

A new kind of instrument for testing all electrical circuits and appliances such as—

- **RANGES**
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ALL MOTORS — single phase, multi-phase, universal, squirrel cage, induction, in fact every type of motor from fractional H.P. to 2 H.P.

THE MODEL 40 UTILITY TESTER:

- Will measure the *actual current consumption* of any appliance or utility either A.C. or D.C. and will measure it *while the unit is in operation.* The reading will be direct in amperes. The appliance or utility may be plugged directly into the front panel receptacle. A special pair of insulated clip-end leads is included for motors, etc.
- Incorporates an ultra-sensitive direct-reading resistance range which will accurately measure all resistances commonly used in electrical appliances, motors, etc. This range will enable continuity checks and tests for shorts and opens. Will read from *a fraction of an ohm* to 25,000 ohms.
- Will indicate when a three phase motor is running erratically due to a "blown" fuse.
- Will indicate excessive leakage between a motor and a line up to 10 Megohms.
- Will indicate whether the voltage is 110 volts or 220 volts, if the current is A.C. or D.C. and if the frequency is 25 cycles or 60 cycles.
- Will test Thermostats under *actual working conditions.*
- Is the ideal trouble-shooter as it will instantly locate opens, shorts and grounds.
- Will test all bulbs, radio tube filaments, pilot light lamps, all fuses including cartridge, screw, etc., fluorescent bulbs, etc.
- Will test condensers for both opens and shorts.
- Will accurately check and locate the exact cause of failure in 3 way heat control switches.
- Will check field coils for opens and shorts.
- Will indicate when one side of an appliance or motor connected to the line under test is "grounded".

The Model 40 Utility Tester comes housed in a rugged crackle finished steel cabinet with portable cover, complete with all test leads and operating instructions —only .....

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ALUMINUM ALLOY—2/3 less weight
With no sacrifice of strength, Kondu fittings make a big cut in the weight of conduit lines or portable equipment.

Practically CORROSION PROOF
Many times more resistant to corrosion than other materials previously used for conduit fittings.

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Threaded Kondu fittings have covers and other accessories interchangeable with the Threadless line. USE THE RIGHT FITTING every time—there's a Kondu that's exactly suited.

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PROTECTS — Fully, automatic thermal relay with unusually long life that eliminates blinking lights and protects all auxiliary equipment.

SIMPLIFIES — Replacement of worn-out lamp automatically restores closed circuit—replacement of starter unnecessary. No button to push.

REDUCES COSTS — Magno-Tronic starters provide exact timing in the lamp electrode—preheating process preventing excessive loss of emission material, thereby assuring the maximum in the useful life of a lamp. The established quality of this starter saves considerable time in maintenance and man hours required to repair and/or replace an inoperative lighting unit.

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GUARANTEED FOR ONE YEAR.

The (SP-15-20) for use with either 15 or 20 watt lamps
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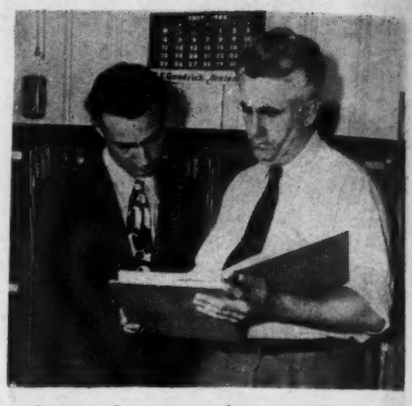

Comprehensive reference library of manufacturers' literature aids Purchasing Agent W. D. Starr of the H. N. Crowder Jr. Company, Allentown, Pennsylvania, to explain pricing and requisitioning procedures to Bob Brokloff, a Junior student in Allentown High participating in an electrical orientation program sponsored by the Crowder organization.

over July of last year but were down 18 percent from the June total. Heavy engineering awards showed an 8 percent increase over July 1947 and a 92 percent gain over June of this year.

Northern Illinois, Indiana, Iowa, Wisconsin, Northern Michigan: Contracts for building and construction awarded in this area in July aggregated $121,625,000. This total reflected a 67 percent increase over July of last year and a 7 percent gain over June of this year. The cumulative seven-months total of $722,336,000 was 60 percent greater than that reported during the corresponding period of last year. Nonresidential awards in July were 101 percent over July of last year and were up 50 percent over the total shown for June. Residential construction in July was 42 percent higher than in July of last year but was down 20 percent from June while heavy engineering awards showed a 47 percent gain over July a year ago and were down 6 percent from June of this year.

Eastern Missouri, Southern Illinois, Western Tennessee and Arkansas: Investment commitments for new construction in this region totaled $65,077,000 in July to show a 49 percent gain over the corresponding month of last year and a 62 percent increase over June of this year. Substantial gains last month brought the cumulative total for the first seven months of this year to a level 38 percent greater than that reported for the corresponding period of last year. Nonresidential awards last month were 153 percent higher than in July a year ago and were up 60 percent over June of this year. Residential contracts showed an increase of 115 percent over July of last year and were up 56 percent over June of this year. Heavy engineering awards

declined 20 percent as compared with July 1947 but were 71 percent higher than the total shown for June.

Louisiana and Mississippi: Last month's awards of $23,841,000 reflected a gain of 29 percent over July of last year and a 24 percent increase over June of this year. Heavy gains made earlier in the year brought the cumulative total for the two states combined to $162,354,000 or 45 percent greater than the total shown for the corresponding seven months of 1947. Last month nonresidential awards were 16 percent higher than in July a year ago but fell off 36 percent from the June total. Residential contracts showed a gain of 188 percent over July of last year and a 15 percent increase over June of this year. Heavy engineering volume in July was 8 percent greater than in July of last year and 186 per cent higher than in June this year.

Minnesota, North Dakota, South Dakota: Contract commitments for investments in building and construction in this region in July totaled $30,050,000 to show a 15 percent increase over July of last year and a 2 percent gain over June of this year. The cumulative total for the first seven months was 35 percent higher than in the corresponding period of last year. Nonresidential awards were up 26 percent last month over the corresponding month of the previous year and 125 percent over June of this year. Residential awards showed an increase of 36 percent over July 1947 and a gain of 17 percent over June. Heavy engineering awards declined 11 percent in July as compared with the total shown for the corresponding month of last year and were down 48 percent from the total shown for June of this year.

Western Missouri, Kansas, Nebraska, Oklahoma: Last month's contract volume of $15,567,000 reflected a decline of 65 percent from the total shown for July of last year and a decline of 77 percent from the total shown for June. Substantial gains made earlier in the year, however, indicated a 47 percent increase during the first seven months over the corresponding period of 1947. Last month's nonresidential awards were less than a quarter of the volume reported for June 1948. Residential awards showed a 46 percent gain in July over the corresponding month of the previous year and a 56 percent increase over June of this year. while heavy engineering awards showed a 9 percent gain over July of last year but were down 9 percent from the total reported for June of this year.

Texas: Last month's building and construction contracts totaled $68,098,000 to show a 36 percent gain over July last year and a 21 percent gain over June of this year. The cumulative total for the first seven months was $429,-

Immediate Delivery
FROM STOCK

Power Circuit Transformers

for Lighting and Operating Machine Tools

ESPECIALLY designed for use on circuits of 600 volts or less. Sizes: 50 V.A. to 37½ K.V.A. Primary and secondary are in separate compartments, eliminating the necessity of additional wiring boxes.

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Same fine staples in a brand new box

Square Shouldered
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Insulation that *stays* on.

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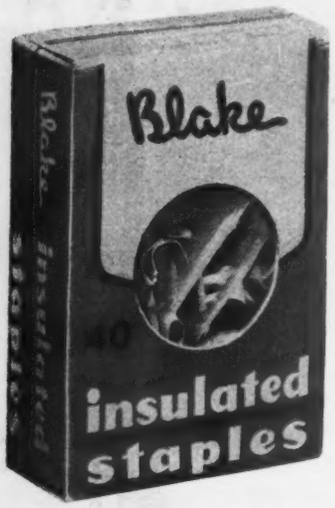

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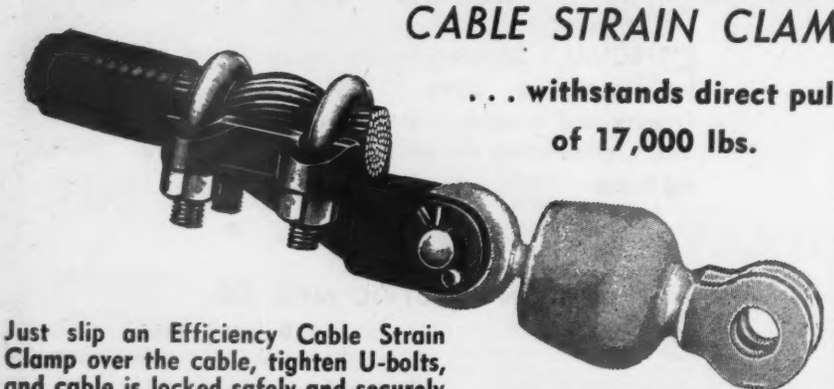
"EFFICIENCY" DEVICES FOR CONDUIT and CABLE SUSPENSION

The POWERFUL GRIP of the "Efficiency" CABLE STRAIN CLAMP



. . . withstands direct pull of 17,000 lbs.

Just slip an Efficiency Cable Strain Clamp over the cable, tighten U-bolts, and cable is locked safely and securely without possible strain or damage. "H" construction of clamp and high ridge across center of cable channel prevents cable from slipping.

Write for Catalog 38-A today.

Note these features:

- **Withstands direct pull of 17,000 lbs.**
- **Takes cable from 1/0 to 1,500,000 c.m.**
- **3 clamp sizes cover all cable sizes**
- **Furnished with eye or clevic**
- **For AC or DC service**

Efficiency
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Motor shop operators Russel Pearson (left), Pearson & Timmerman, Watertown, N. Y., and A. N. Buckner, Buckner Electric, Kokomo, Indiana, discuss merits of NISA Award Contest Entries.

356,000, a gain of 20 percent over the corresponding period of last year. Nonresidential awards last month were up 82 percent over July of last year and were up 10 percent over June of this year. Residential contract volume in July was 4 percent higher than in the corresponding month of the previous year and was up 9 percent over June of this year while heavy engineering awards showed a 14 percent increase over July of last year and a 84 percent gain over June of this year.

Ambient Temperatures Affect Overcurrent Devices

Reports of operating difficulties under service conditions involving extreme cold weather prompted an investigation by Underwriters Laboratories of overcurrent protection devices to determine the effect of ambient temperature on their performance. Calibration tests were conducted on representative samples of circuit breakers and fuses under predetermined test conditions of current flow and temperature.

A total of more than 3,500 tests led to the following summary of the findings:

1. At 30 F the effective ampere rating of a 15-amp. circuit breaker or plug or cartridge fuse can be expected to increase approximately 12 to 50 percent.

2. At O F there is a corresponding increase in effective rating from approximately 5 to 35 percent, depending on the type of device.

3. As a matter of interest, it was also recorded that at 100 F a decrease in effective rating to about 90 to 97 percent of normal rating may be expected.

These findings confirm a view previously held that thermally operated devices are affected by the ambient temperature at which they are operated, and this should be taken into account when considering these findings in actual practice.

Details of the tests are reported in the Underwriters Laboratories, Inc. Bulletin of Research No. 41.

Electricity to Rural America

The job of taking electricity to rural America is nearing practical completion, it was announced today by Charles E. Oakes, President, Edison Electric Institute.

"Rural electrification will be practically complete in 1951," Mr. Oakes said. "Work now in progress or definitely planned will connect an additional 1,330,000 rural dwellings to power lines by the end of that year. Most of these dwellings are on farms.

"At the end of 1947, 12,900,000 rural dwellings, or 82 per cent of the total of 15,800,000 occupied rural dwellings in the United States were being served by electric power lines. An additional 1,300,000 rural dwellings were reached by power lines, although not yet taking service. The total of 14,200,000 rural dwellings served or reached by power lines constitutes 90 per cent of the total number of rural dwellings.

"Of the 12,900,000 rural dwellings taking electric service at the end of 1947, business-managed electric companies served 10,600,000 or about 82 per cent; REA cooperatives served 2,030,000 or about 16 per cent; and 300,000 dwellings about 2 per cent, received service from municipal and other government agencies.

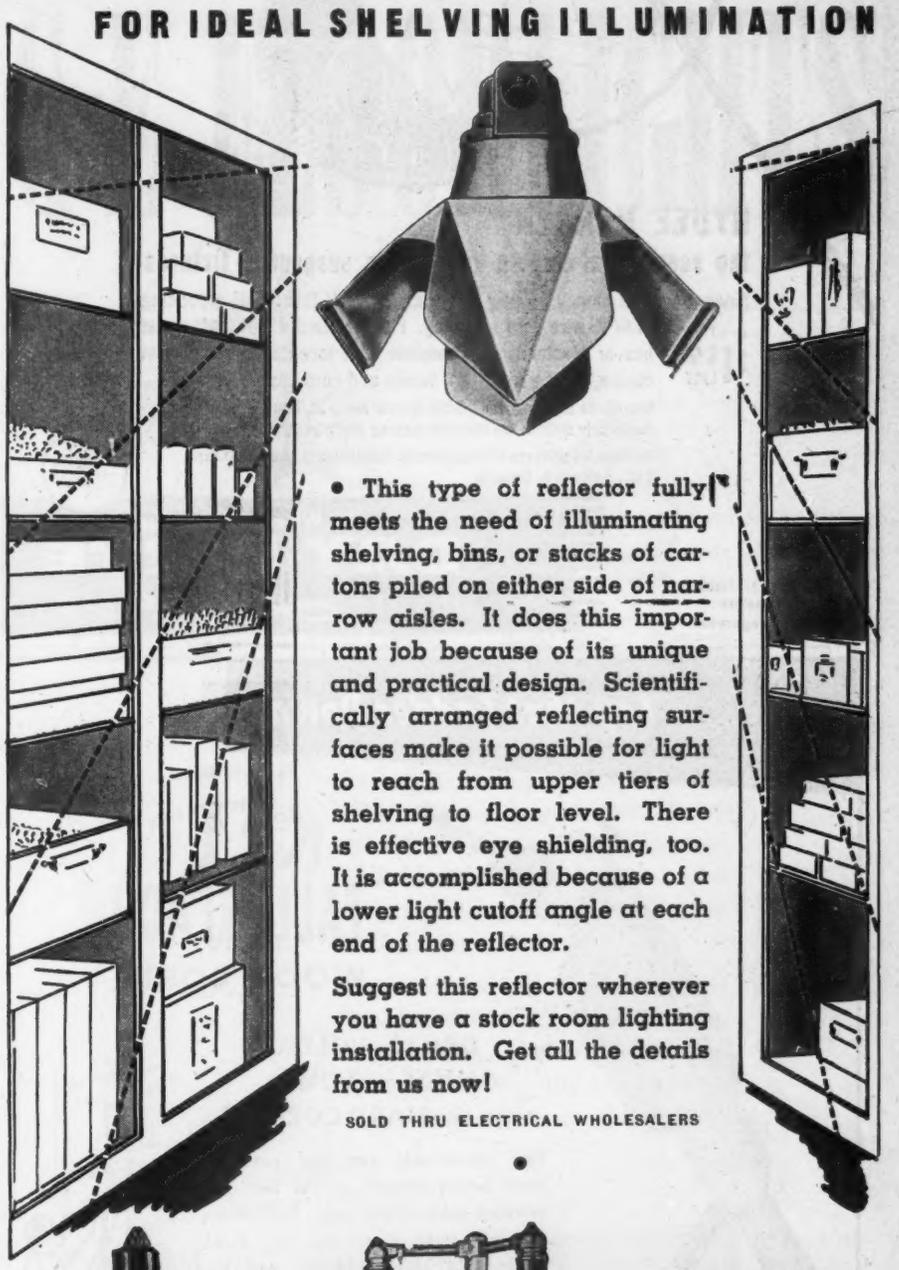
"By the end of last year 8,600,000 dwellings in the rural non-farm classification had electric service, or had it available near by. This figure is about 96 per cent of the 9,000,000 dwellings in this category which includes dwellings in communities of less than 2,500 population and neighboring dwellings just outside corporate town limits. Of the 6,800,000 farm dwellings making up the remainder of the 15,800,000 rural dwellings, 5,700,000 or 84 per cent were wired for electricity or were near enough to rural power lines to take service. Slightly more than 100,000 isolated farms are now served by home electric lighting plants."

Virtually all of the 15,800,000 oc-

QUAD

AISLE STOCK REFLECTORS

FOR IDEAL SHELVING ILLUMINATION

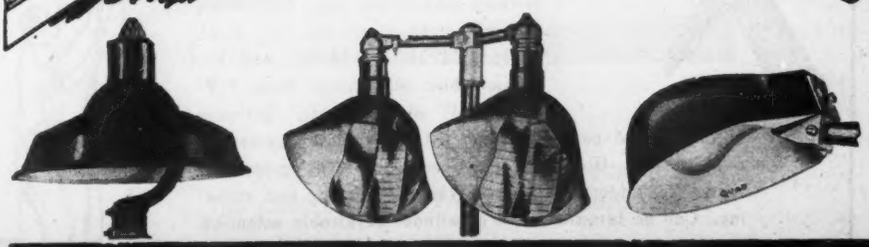


• This type of reflector fully meets the need of illuminating shelving, bins, or stacks of cartons piled on either side of narrow aisles. It does this important job because of its unique and practical design. Scientifically arranged reflecting surfaces make it possible for light to reach from upper tiers of shelving to floor level. There is effective eye shielding, too. It is accomplished because of a lower light cutoff angle at each end of the reflector.

Suggest this reflector wherever you have a stock room lighting installation. Get all the details from us now!

SOLD THRU ELECTRICAL WHOLESALERS

•



QUADRANGLE MFG. CO.

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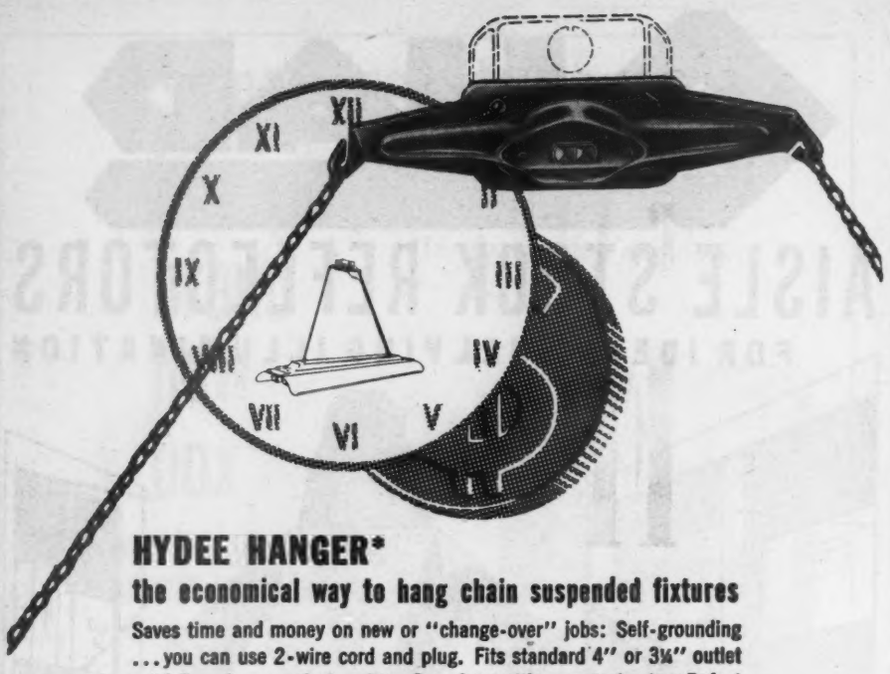

HYDEE HANGER*

the economical way to hang chain suspended fixtures

Saves time and money on new or "change-over" jobs: Self-grounding ...you can use 2-wire cord and plug. Fits standard 4" or 3¼" outlet box or plaster ring. **Complete** with receptacle, two 5-foot chains, spring wire "S" hooks and cord clips.

$1.65 LIST

Day-Brite Lighting, Inc., 5402 Bulwer Ave., St. Louis 7, Mo.
Nationally distributed through leading electrical supply houses.
In Canada: address all inquiries to Amalgamated Electric Corp., Ltd., Toronto 6, Ontario.

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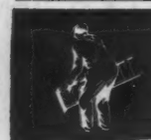
IT'S EASY TO SEE WHEN IT'S DAY-BRITE Lighting

*Patent No. D-141084 and No. 440914
Underwriters approved.



Lay that Ladder Down!

KETT TALL REACH WOOD BORER

DRILLS HOLES HIGH ... LOW or in the HARD CORNERS

This sensational new tool pays for itself (users report) on the first two or three construction jobs. Drills holes through joists, concrete or steel. 11/16", 12/16" or 16/16" and expansion bits with range from 7/8" to 2 3/4" are available. Exclusive all-angle head permits drilling extremely close quarters in any direction. Use for wiring, plumbing or heating installations. No ladders, no more reaching, stretching and straining. Can be furnished with or without adjustable extension.

WRITE FOR BULLETIN No. F-10

The KETT Tool Company
5 E. THIRD ST., CINCINNATI 2, OHIO

cupied rural dwellings in the nation, except for approximately 400,000 dwellings so isolated as to be beyond feasible reach of power lines, will be enjoying electric service or will have it available near at hand within the next four years, according to Mr. Oakes.

"The speed shown in the electrification of the nation's rural areas is a striking example of American progress. In 1940 only 65½ per cent of the occupied rural dwellings were served or reached by power lines. By 1951, except for the most isolated dwellings, we should be comfortably close to 100 per cent. To achieve this goal of almost complete rural electrification, more than 452,000 miles of power lines will be constructed during the next four years—enough to circle the globe about 18 times."

Book Reviews

Electricians' Handbook

The sixth edition of the "American Electricians' Handbook" is a practical guide packed with facts, fundamentals and practical suggestions for tracing, analysing and correcting electrical faults. Selecting equipment, installing, operating and maintaining it are discussed in detail. Originally designed for the trained electricians and engineers, it has been revised to also include basic data essential for complete understanding by those with little electrical experience. Subjects include electron tubes and circuits, fundamentals of construction, operation and application of electronic devices in industry, control generators, electronic control of motors, automatic electric drive control, synchros, dry-type transformers, copper-oxide and selenium rectifiers, signalite fuses, thermoplastic insulated wire, load-center industrial distribution systems, fluorescent lamp development and farm wiring. All material has been reviewed and corrected to conform with the National Electrical Code. With 1774 pages, the handbook measures 5-by-7½-inches and is priced at $6.00 by the McGraw-Hill Book Company, Inc.

Centrifugal and Axial Flow Pumps

The progress in the design and application of centrifugal pumps has been so rapid that at present almost all limitations of pressure, capacity,

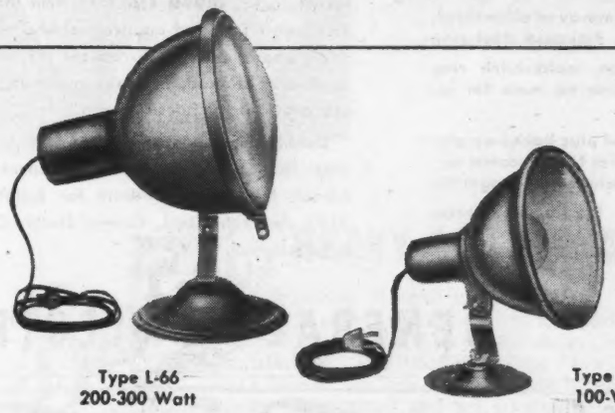
temperature, nature of liquids and speed of operation have disappeared. This advance in construction and application has presented numerous problems—mechanical, hydraulic, operating and economic. This advance in pump design necessitated theoretical and experimental studies of cavitation, operation outside the normal head-capacity and speed range, axial and radial thrust, effects of stuffing boxes on critical speeds of shafts, control of brake-horsepower curves and pumping of viscous liquids. This research, development and new application is thoroughly discussed by A. J. Stepanoff in his new book, "Centrifugal and Axial Flow Pumps". Doctor Stepanoff, a development engineer for Ingersoll-Rand, is the author of numerous articles on centrifugal pumps, the winner of the ASME Melville Medal, and recipient of three first prizes (1941, '42 and '43) from the Hydraulic Institute. Numbering 428 pages and measuring 6¼-by-9¼-inches, the book is priced at $7.50 by John Wiley and Sons, Inc., New York City.

Fractional Horsepower

Practical information on fractional horsepower motors of every description is included in "Fractional Horsepower Electric Motors", Second Edition, by Cyril G. Veinott, Manager, Induction Motor Section, Small Motor Division, Westinghouse Electric Corporation. Completely revised from the first issue, it is designed for repair men, operating engineers, maintenance men and salesmen. It discusses repair, maintenance, application, inspection, selling, testing, manufacturing and design, with particular attention directed to standards established by the ASA, NEMA and AIEE. Practical and accurate, it provides easy-to-follow descriptions of single-phase and split-phase induction motors, capacitor-start, repulsion-start, universal, polyphase induction, synchronous, direct-current and other types. It analyses fractional horsepower testing, discussing constitutional features common to more than one type, and discusses selection of the proper motor for a specific job. Special attention is given to electrolytic capacitors, regeneration, all-purpose capacitor motors, procedures for refinishing commutators and laying out coil groupings of slot windings. Measuring 6¼-by-9¼ inches, the book contains 554 pages with numerous charts, diagrams, tables, drawings and photographs. Priced at $5.00, it is published by the McGraw-Hill Book Company.

Handy is the word for these *low-cost*

G-E FLOODLIGHTS



Type L-66
200-300 Watt

Type L-65
100-Watt

AS LOW AS $3.95
AVAILABLE FROM STOCK
WIDE BEAM—ALUMINUM
CLAMP AND SNAP RING DOOR ASSEMBLIES

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order now to have them
when you need them

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For more information, phone your nearest G-E agent or write Apparatus Department, General Electric Co., Schenectady 5, N. Y.

GENERAL ELECTRIC AGENTS STOCK
THE COMPLETE LINE OF G-E FLOODLIGHTS

GENERAL ELECTRIC

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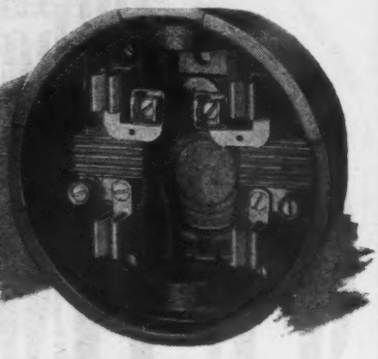
NEW STANDARDIZED DEEP METER SOCKET

Low price plus these advantages...



1. Additional wiring space for more liberally rated conductors
2. Greater ease of connecting larger conductors
3. Increased current-carrying capacity
4. New and improved all-welded, one-piece, stainless steel ring
5. Snap-action, quick-hitch ring that requires no tools for installation
6. Bonderized plus baked-on aluminum paint for increased corrosion resistance and longer life
7. Two-way ($3.00 list) three-way ($3.85 list), subject to change without notice.

This new type R-1 four-terminal standardized socket covers with one catalog item the widest practicable range of applications and ratings for single-phase metering. It reduces the number of items to be stocked, increases interchangeability, and provides for future growth.

Detailed specifications and prices are available from your nearest G.E. representative. Consult him today, or write for Bulletin GEA-5147. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

GENERAL ELECTRIC

601-42

CELLOPHANE WRAPPED AND SEALED...THAT'S PROTECTION!
GOLD SEAL
GOLD SEAL
TRADE JENKINS MARK
NO DOUBT ABOUT IT IT'S THE BEST BUY IN TAPE!

Best Buy

FOR BIG USERS ... the BIG 10-ROLL CAN of GOLD SEAL TAPE

● Off the market during the war, this handy 5 pound can of Gold Seal Tape is back again . . . the best buy for regular users. Every roll is doubly protected for factory freshness.

Whatever way you buy tape, you'll find Gold Seal always just right in "tack"; clean handling; non-raveling; non-peeling. Try it. Jenkins Bros. (Rubber Div.) 80 White Street, New York 13.

Jenkins Bros. also make Diamond Seal Friction and Rubber Tapes which meet ASTM and Federal Specifications.

JENKINS Gold Seal Tapes

FRICTION-RUBBER

MADE BY JENKINS BROS. ... MAKERS OF FAMOUS JENKINS VALVES

Battlefronts of Industry

The story of American industry during the war years is just now being revealed in its entirety and "Battlefronts of Industry" should be of particular interest to those connected with the electrical field for two reasons. First; it is the story of Westinghouse in World War II. It is a tale of an answer to a national emergency, a story of cooperation between management and labor, a statement of the development of mechanical and electrical genius formerly undreamed of. It tells how Westinghouse designed and produced everything from electric torpedoes and tank gun stabilizers to optical instruments, insecticide containers, bomb fuses, precipitrons, aviation gas turbines, jet propulsion units, uranium by the ton, mobile power houses and machinery for producing the atomic bomb. Although based on Westinghouse activities, it reveals the tremendous part played by the electrical industry as a whole and describes in absorbing detail the discovery of new principles and the application of old theories to new purposes. The second reason for its interest lies in the versatility of author David O. Woodbury, for it is unusual to read a book prepared by one who is trained for literary style as well as technical analysis. Mr. Woodbury, with engineering, arts and science degrees from M.I.T., Harvard and Stanford, is an engineer, radio and movie producer, lecturer and teacher. Illustrated with fine photographs, the 6-by-9¼-inch cloth-bound book is 342 pages in length, is priced at $3.50 and is published by John Wiley and Sons, Inc., New York.

Lighting to Stimulate People

A new approach to the subject of lighting has been used by the author of a recent book titled, "Lighting to Stimulate People". This approach is based on the psychological reactions which different types of people give to each of the more common types of lighting effects. Types of people are classified according to their various requirements for illumination, and their reactions studied and described when subjected to different lighting effects. Through this approach the author develops a key to harmonized lighting, which is shown in chart form.

The author has based his theory of lighting on analyses of activities of people, predicated on natural lighting

Cove lighting features in the cocktail lounge of the remodelled and newly decorated Rochester Club are pointed out to N. J. Masuchi (left), architect's representative, and Realto E. Cherne (right), consulting engineer, upon completion of the job by Ray F. Hornbeck, President, T. H. Green Electric Co., Inc., Rochester, N. Y. electrical contractors who installed the completely new lighting and new wiring system.

effects under which man has evolved and developed. It is directed primarily to lighting specialists. Since it deals with applications of lighting systems of different types, it will also appeal to the architect, designer, plant engineer, or others interested in selecting lighting effects which will provide the greatest service possible for its user.

"Lighting to Stimulate People" was written by J. Lloyd Kamm, Illuminating Engineer, who has had twenty years experience in selling lighting and lamps. It contains 21 chapters in 174 pages, and 35 illustrations. It is published by The Christopher Publishing House, 1140 Columbus Avenue, Boston 20, Massachusetts. Price is $2.50.

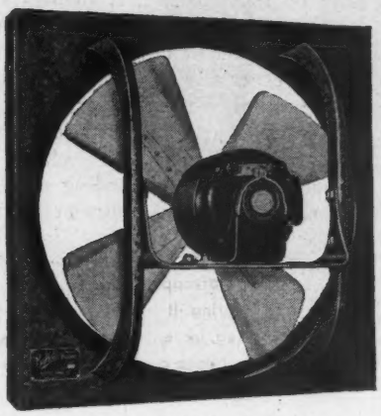
Practical Color Simplified

Color is a general term. It relates to light in the visible part of the spectrum and all the hues, tints, shades, values, strengths, and intensities thereof which may be produced by their mixture. It also relates to material substances such as lacquers, pigments, stains, dyes, and so forth. It is a most important subject for men of industry and commerce, since color plays such an important part, either consciously or unconsciously, in the life of everyone.

Some of the more important funda-

AIR EQUIPMENT TO HELP YOUR BUSINESS

For Simple Installation on VENTILATING JOBS



Here's an exceptionally husky, quiet-running disk fan for installation on jobs up to ¼" duct or other resistance.

"Buffalo" HEAVY-DUTY BREEZO

Nothing "flimsy" about this fan! You can put it on ventilation jobs in a capacity range up to 15,000 cfm, ¼" s.p., and expect long-term satisfaction. The "Buffalo" Type "NV" Heavy-Duty Breezo Fan has a sturdy four-bladed wheel —blades die-stamped and set at the correct angle for full rated air delivery. Its motor bracket and welded-on bracket arms are RIGID—and motors furnished are of first quality. And you'll appreciate the square panel when it comes to installing. Better have all the facts for best results on your next disk fan job—write for Bulletin 3222-F now!

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★ HEATING
★ COMFORT COOLING
★ PROCESS COOLING
★ AIR TEMPERING

★ AIR WASHING
★ EXHAUSTING
★ BLOWING

FOR

★ FORCED DRAFT
★ INDUCED DRAFT
★ PRESSURE BLOWING
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CUTTING COSTS IN EVERY BRANCH OF INDUSTRY

Speed Wiring— Save Tape

with **IDEAL**
FISH TAPE, REEL and PULLER

3 TOOLS IN ONE

This handy device belongs in every wireman's kit. Gives complete control of Fish Tape . . . keeps it reeled up . . . prevents springing and breaking . . . helps workman avoid "live" parts. Makes it easy to pull tape through conduit quickly without kinks or bends. No slipping. Gives a *big* grip. Tape is easy to reel in or pay out. 7 sizes. Ideal Fish Tapes are made of highest grade tempered spring steel wire—non-curling.

IDEAL VOLTAGE TESTER

Not an ordinary "glo" type—actually indicates nominal line voltage on easy-to-read scale, calibrated from 110 to 600 volts. DOUBLE PROTECTION — Combines solenoid indicator *and* neon test lamp. Tests AC or DC circuits. Complete with carrying case.

"E-Z" HAND TYPE STRIPPER and CUTTER

For solid or stranded wire. Always ready—no cocking. *Triple action* . . . clamps wire, cuts insulation . . . strips—all in one operation. Eliminates wire waste. Made in two models. "Automatic" has lever to stop return of arms till stripped wire is removed.

"SAFE-T-GRIP" FUSE PULLER

No Slip! Formed to fit fingers; assures positive, full grip. Safe, handy, inexpensive. Eliminates danger, prevents bending of fuse clips. Three sizes. Many uses.—IDEAL INDUSTRIES, Inc., Sycamore, Ill.

IDEAL

Distributed Through
America's Leading Wholesalers

mentals of color as it relates to the visible spectrum, and valuable information on lacquering, enameling, coloring and painting have been incorporated in "Practical Color Simplified". This is a revised edition brought up to date, and gives special attention to mixing, choosing, harmonizing, matching, lighting, testing and designation. Written in simple language and carefully indexed so that specific subject matter may be found easily, it furnishes the latest and most concrete information on the subject of finishing. It will be found especially useful to a large group ranging from advertising men, artists and art students to varnish manufacturers, vocational schools and window trimmers, including chemists, colorists, engineers, enamelers, factory managers, ink makers, japanners, lacquerists, and many others. It is fully illustrated with pictures, tables and color plates, including the Miskella patented color chart which enables the mechanical selection of colors, mixing of shades and tints, and the harmonizing of three or more colors and prevention of color discords. It contains general and important information on color choosing, color mixing, color matching and color harmonizing incidental to practical finishing.

There are thirteen chapters in "Practical Color Simplified" and 113 pages. The author is William J. Miskella, who has written other books on enameling, lacquering, and painting, and "Infra-Red in Industry". The book is 5¾ in. by 8½ in., and its cover is water-proof, vermin-proof and resistant to wear. It is published by The Miskella Infra-Red Company, Publishing Division, Cleveland 4, Ohio. Price $5.00.

Dates Ahead

International Municipal Signal Association—53rd Annual meeting, Hotel Statler, Buffalo, N. Y., October 4-7.

New England Materials Handling Exposition—Mechanics Hall, Boston, Mass., October 5-7.

Porcelain Enamel Institute — Annual forum, University of Illinois, Urbana, Ill., October 13-15.

National Association of Housing Officials —Third annual exhibit of building and maintenance products, Olympic Hotel, Seattle, Wash., October 13-16.

International Association of Electrical Inspectors—Eastern Section, Seaside Hotel, Atlantic City, N. J., October 11-13; Southern Section, Heidelberg Hotel, Jackson, Miss., October 18-20.

American Institute of Electrical Engineers — Fall General Meeting, Hotel Schroeder, Milwaukee, Wis., October 18-22.

Illinois Chapter, NECA—Peoria, Ill., October 23.

National Metal Congress and Exposition —Annual convention, Philadelphia, Pa., October 25-29.

National Electronics Conference — Edgewater Beach Hotel, Chicago, Ill., November 4-6.

National Electrical Manufacturers Association—Traymore Hotel, Atlantic City, N. J., November 7-12.

Electrical & Gas Association of New York, Inc.—Luncheon meeting, Grand Ballroom, Hotel Astor, New York, N. Y., November 17.

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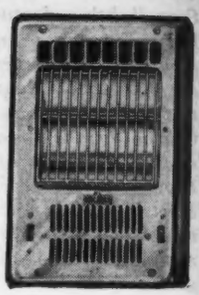

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Every FAN-GLO HEETAIRE available with Thermostatic Control. Automatic range from 56° to 84° F. Ivory enamel case—equipped with thermometer (Underwriters' Approved).

New recessed Heetaires (series 230 and 240) are available in special electrically baked ivory and brown enamels — in addition to Nuchrome — for living rooms, dining rooms, bedrooms, etc. That means more sales — more profits for you!

MORE PROFITS for you . . . because it's backed by powerful selling ammunition — sales literature, catalog and specification sheets and charts, national magazine and newspaper ads telling millions of prospective customers that FAN-GLO HEETAIRE is the only heater that gives BOTH kinds of heat — Warm Comfort Quickly.

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MARKEL ELECTRIC PRODUCTS
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Getting the latest information on Fiberglas insulations from Harry O. Collis (center), Owens-Corning Fiberglas Corp., Toledo, Ohio, are G. E. Duerr (left), industrial engineer, West Penn Power Co., Pittsburgh and Arch M. Steele, chief engineer, Oswald Werner & Sons Co., Pittsburgh.

National Farm Electrification Conference—Congress Hotel, Chicago, Ill., November 17-19.

National Electrical Contractors Association — 47th Annual Meeting, Roney Plaza Hotel, Miami, Fla., November 30-December 3.

Electrical & Gas Association of New York, Inc.—Luncheon meeting, Grand Ballroom, Hotel Astor, New York, N. Y., December 22.

Independent Electrical Contractors Association, Inc.—43rd Annual dinner, Hotel Astor, New York, N. Y., January 15, 1949.

American Institute of Electrical Engineers—Winter general meeting, Pennsylvania Hotel, New York, N. Y., January 31-February 4, 1949.

National Electrical Manufacturers Association—Winter convention, Edgewater Beach Hotel, Chicago, Ill., March 13-18, 1949.

Third International Lighting Exposition and Confermence — Hotel Stevens, Chicago, Ill., Week of March 28, 1949.

National Electrical Wholesalers Association—41st Annual Convention, Netherland Plaza Hotel, Cincinnati, Ohio, May 1-6.

Chamber of Commerce—37th annual meeting, Washington, D. C., May 2-5.

National Fire Protection Association—53rd annual meeting, Fairmont Hotel, San Francisco, Calif., May 16-19.

National Industrial Service Association—Annual convention, St. Louis, Mo., June 6-8.

Manufacturers News

Ward Harrison Retires From General Electric

Dr. Ward Harrison, international authority on lighting, and director of engineering for General Electric's Lamp Department at Nela Park, Cleveland, resigned on September 1. He has been with the Lamp Department for 39 years.

Dr. Harrison has been a director of the American Coach & Body Company of Cleveland, and as of September 1 he became a consultant for Curtis Lighting, Inc. of Chicago and a director of that company. For a time he will carry on a special assignment for the G-E Lamp Department, and

Now — YOU CAN CONVERT YOUR PIPE BENDER TO POWER OPERATION

Enjoy These Benefits —
Less Fatigue
Work More Bends Per Hour
Savings in Time
Extra Versatility

NEW P-182
ELECTRICALLY-DRIVEN HYDRAULIC PUMP

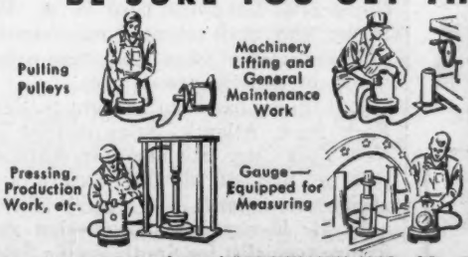
Here's Why It's a "Profit Package" for You

Economy — P-182 pays for itself on labor-saving alone. One electrical contractor estimated a saving of $63 in FOUR HOURS . . . through labor savings in making offsets on 60 pieces of 1½" pipe.

Speed — This handy pump slashes pipe bending time. Full ram travel can be obtained in ⅓ the time it takes with hand operation. And P-182 never tires — it works at top speed all day — turns out more than 3 times as much work as a hand-operated pump.

Versatility — P-182 is a complete package containing pump, valves, and controls. Conversion is simple — disconnect your hand-operated Porto-Power pump, connect P-182 and go to work. It takes the place of one or many hand pumps, handling 2 to 25 rams at one time. And P-182 is adaptable to any hydraulic system.

BE SURE YOU GET THIS EXTRA UTILITY



Blackhawk Porto-Power Pipe Benders do MORE than bend pipe. The hydraulic ram is detachable for use with P-182 and Porto-Power attachments on many other production and maintenance jobs such as machinery lifting, pulling pulleys, etc.

A Product of BLACKHAWK MFG. CO., Dept. P20108, Milwaukee 1, Wisconsin

BLACKHAWK

"Drive-It"
The Powder-Powered Tool That
DRIVES STUDS
into Concrete
or Steel
Instantly

Saves Time, Labor and Cost on Every Anchoring Job!

"DRIVE IT" drives threaded studs 3 inches into concrete or through 5/8-inch steel. Eliminates all drilling, hammering and expansion bolts. "DRIVE-IT" has made tremendous cost cuts in construction work, plumbing, air-conditioning, plastering, maintenance, highway and electrical work.

- WORKS INSTANTLY
- ANY DESIRED STUD OR PUNCH
- CARRIES ITS OWN POWER
- ABSOLUTELY SAFE
- UP TO 6000 LBS. HOLDING POWER
- NO RECOIL OR SHOCK
- LIGHTWEIGHT — EASY TO OPERATE
- ADJUSTABLE FOR ANY DEPTH
- NO DRILLING OR HAMMERING

40 Different Types of Studs, Rivets, Bushings and Punches

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Gentlemen: Please send me illustrated folder on "DRIVE-IT" Powder-Power Tools.

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DR. W. HARRISON

W. C. BROWN

also will be associated with the Thompson Electric Company of Cleveland. Dr. Harrison has announced that he expects to continue active in the Illuminating Engineering Society and other engineering society affairs.

He will be succeeded by Willard C. Brown, who during his 28 years with the company has headed its activities in many fields, and has become widely known throughout the electrical industry. He has been assistant to Dr. Harrison since 1945.

The new manager of the G-E Lamp Department's Engineering Division joined the division in 1920, and since has been active in lighting for the automotive, advertising, theater, farm, school, industrial, and other fields.

Appointment of six persons in the field organization of the Lamp Department to key positions in the general sales headquarters division at Nela Park was announced recently by P. D. Parker, general sales manager.

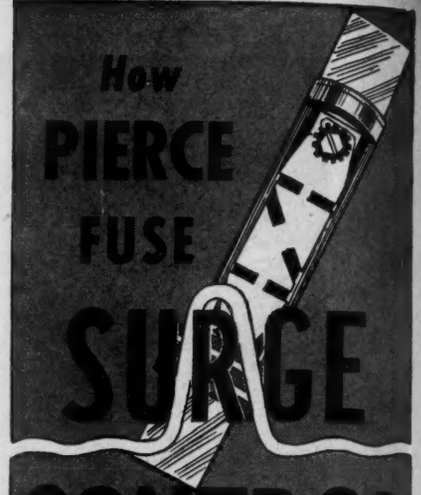
Named to the post of industrial and commercial lamp specialist is W. W. Becky who, until recently, was responsible for sales of glow lamps and other lamps in the Cincinnati area.

J. B. Foley has been brought to Nela Park from Atlantic Sales district in New York City. His new responsibility will be that of lighting fixture and utility promotion.

L. H. Hruby, sales promotion and fixture specialist for South Pacific Sales district at Los Angeles, has been named health lamp specialist.

G. B. Davis, salesman with Buckey Sales district at Columbus, Ohio has been named miniture lamp retail

How PIERCE FUSE SURGE CONTROL SAVES TIME.. CUTS PRODUCTION LOSS!



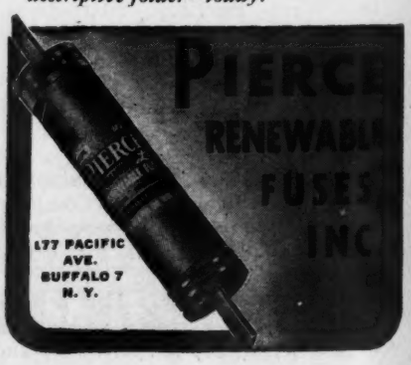
Through a close control of the current surge which results from low or momentary high overload, PIERCE Fuses keep your production line humming. No unnecessary shutdowns . . . no lost labor time . . . no production sag, when PIERCE Fuses are in your plant!

Here's how PIERCE Fuses produce cost-saving Surge Control:

BALANCED LAG LINK — creates more lag at low overloads — where it is necessary and harmless; gives Safe lag at high overloads.

SCREEN VENTILATION —takes in cool air and allows escape of heat and gases, reducing unnecessary fuse blowing and banishing dangerous "afterblow".

GET THE FULL STORY of the cost-saving Surge Control features of Pierce Renewable Fuses. Write for descriptive folder--today!



specialist. R. B. Smith of Philadelphia service district has been put in charge of office operation for general sales division and will handle other duties to be assigned to him.

Named to post of photolamp specialist is B. C. Christman of Allegheny Sales district in the Youngstown area.

R. T. Cheeseman, manager of engineering for General Electric's Lighting and Rectifier Division, retired September 1 after 45 years service with company. He has been succeeded by H. J. Flaherty, formerly division engineer.

Sales responsibility for tungar and metallic rectifiers was transferred on October 1 from the Construction Materials Department to its Apparatus Department. C. E. Hamann, formerly of the Construction Materials Department, will be responsible for the sales and application engineering phases of the rectifier business under the direction of F. D. Crowther, manager of sales, lighting and rectifier divisions.

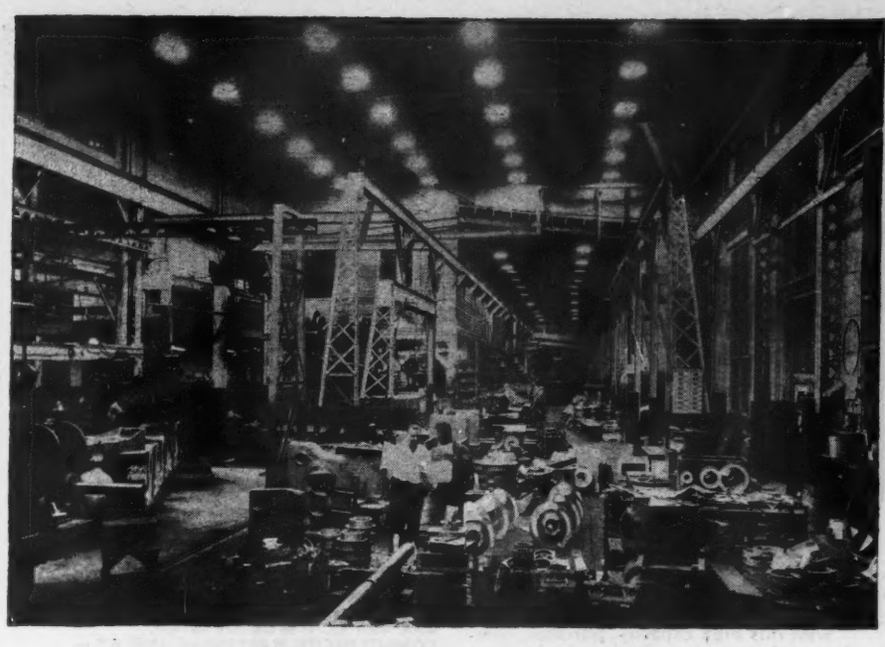
Holophane Appoints Three Vice Presidents

Election of Clarence C. Keller, Stuart R. Williams, and Kurt Franck as vice presidents of the Holophane Company, Inc., New York City, has been announced.

Mr. Keller joined the organization in 1929 upon graduation from Ohio State

C. C. KELLER

S. R. WILLIAMS



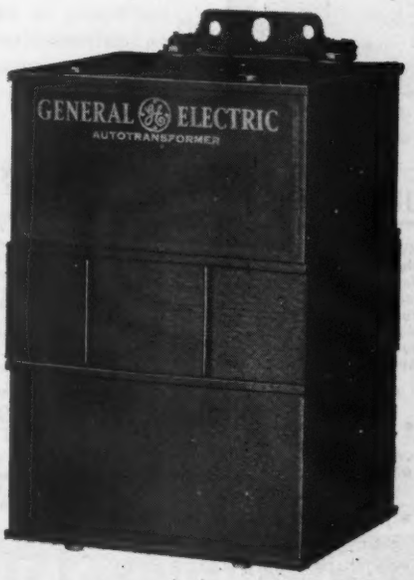
Modern Mercury Lighting costs even less with GE Tulamp Ballasts

It's a proved fact that mercury-vapor lamps are roughly *twice as efficient* as filament lamps—and when used for high-level illumination, much more economical. By using G-E Tulamp Ballasts with Mercury lamps, you make even greater savings—both in installation and operating costs.

All Tulamp Ballasts do "double duty." They combine the ballast of two lamps into a *single compact unit*—thus cutting in half the number of ballasts to be installed. By carrying a common ground to the lamps, installation is further simplified.

Other features—a power factor of 90 to 95 per cent, reduced ballast losses, and lower starting current characteristic—also mean a reduction in wiring costs, savings in operation. Copper, fuses, and switch ratings may be based on operating current—not starting current.

G-E Tulamp Ballasts are designed for both the H-1 400-watt lamp and the H-5 250-watt lamp. Single lamp units available for operation of all standard lamps. For full information on General Electric's complete line of mercury ballasts, address the nearest G-E office, or *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*



GENERAL ELECTRIC

412-40

New LIGHTWEIGHT ELECTRIC PLANT

5000 WATTS D.C.

Weighs only 315 lbs.!

Model 5CK-115M, 5,000 watts, 115 volts D.C.

Use fast-working electrical tools on any construction or maintenance job with this high capacity, portable, compact electric plant. Equipped with four-receptacle box for direct plug-in of tools or lights. Available with carrying frame, or dolly-mounted. Powered by Onan 10 HP, two-cylinder, 4-cycle, air-cooled engine. Shipped complete . . . ready to go!

NEW ONAN "CK" ELECTRIC PLANTS are available in 5000 watts D.C., 115 and 230 volts; 2000 and 3000 watts A.C. in all standard voltages.
COMPLETE ELECTRIC PLANT LINE INCLUDES: A.C.—350 to 35,000 watts in all standard voltages and frequencies. D.C.—600 to 15,000 watts, 115 and 230 volts. Battery Chargers—500 to 6,000 watts, 6, 12, 24, 32 and 115 volts.
ONAN AIR-COOLED ENGINES—CK: 2-cylinder opposed, 10 HP. BH: 2-cylinder opposed, 5½ HP. JB: 1-cylinder, 3¼ HP.

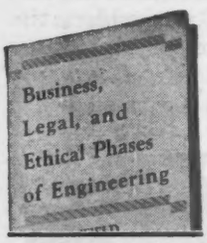
Onan PRODUCTS

Write for catalog

D. W. ONAN & SONS INC.
2143 Royalston Ave., Minneapolis 5, Minn.

ONAN ELECTRIC PLANTS

Now . . . Sound BUSINESS Know-how for the Engineer and Contractor



Here's a guide that helps you make sound business decisions in your engineering and contracting work. It gives you a handy source of up-to-the-minute data on engineering economics, engineering ethics, business law, patents, bids and specifications. Written expressly for engineers, by engineers, its profit-promising information on business economy, cost determination, and engineering procedures enriches your business know-how.

By D. T. Canfield M.S.E.E., E.E. and J. H. Bowman M.S.E.E., E.E.

JUST OUT

BUSINESS, LEGAL and ETHICAL PHASES of ENGINEERING

351 pages, 29 tables, 14 figures, $4.50

Hundreds of tables, charts, do's and don'ts of engineering ethics, the 22 codes of professional conduct help you develop sound business procedures.

No matter what your position in the field, this manual answers your questions on subjects ranging from money, interest, and discount to insurance, industrial hazards, and employment compensation. It shows you: how to evaluate profit-promising opportunities, how to steer clear of bad contract liabilities, how to use money and machines efficiently, how to handle insurance matters, how to establish annuity funds, etc. This practical refresher includes typical problems that reflect everyday situations in your field. If you want to brush up on business and legal practices, this is THE BOOK FOR YOU.

This book shows you:

- how to estimate depreciation
- how to prepare an adequate income statement
- how to write a good bid or specification
- how to apply for a copyright, patent or trade mark
- how to find the yield on extra investment
- how to determine gross revenue of a public utility

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KURT FRANCK

University. He was made sales manager in 1943, from which position he is now elevated to vice president in charge of sales.

Silvray Appointments

Henry G. Clum has been appointed sales manager of Silvray Lighting, Inc., New York City. He will be in charge of field sales and promotion.

Mr. Clum was formerly general sales manager of Art Metal Company in Cleveland and prior to 1945 he was

H. G. CLUM

associated with the Jersey Central Power & Light Co. of Asbury Park, N. J., as manager of lighting sales department.

Westinghouse Changes

Dr. L. W. Chubb, director emeritus of the Westinghouse Research Laboratories, has retired after 43 years of scientific research with Westinghouse, leaving behind him a record of outstanding contributions in nearly every field of science and engineering. Last year Dr. Chubb was awarded the John Fritz Medal, the nation's highest tribute to scientists and engineers.

The appointment of E. B. Bremer as electrification manager in the northwestern district of Westinghouse Electric Corporation, has been announced.

D. I. Packard Elected Vice President

The directors of the Pyle-National Company, Chicago, have elected Durward I. Packard, vice president in charge of sales. He was formerly district manager of the Baldwin Locomotive Works.

D. I. PACKARD

Mr. Packard during World War II was a dollar a year man with WPB. Before that he was associated with the New York Central Railroad and the Franklin Railway Supply Company.

Wesco Appointments

A new Westinghouse Electric Supply Company house was opened recently at 26 Liberty Street, Newburgh, N. Y. R. E. Roberts has been named branch manager.

Harold W. Marvin, Jr. has been appointed branch manager of the Raleigh, N.C. house. He was formerly an apparatus salesman in Charlotte, N.C.

With the opening of a new Wesco house at 603 North Gilbert Street, Danville, Ill., W. T. Gibson has been appointed branch manager.

W. L. Houghland has been appointed West Central District Farm Sales Supervisor, with headquarters in Cincinnati.

Skilsaw Elections

The election of Walter W. Kemphert as vice president in charge of sales of Skilsaw, Inc., Chicago, has been announced. He joined Skilsaw after 20 years with Worthington Pump & Machinery Corp., Harrison, N. J.

Mr. Kemphert's career with Worthington started in 1928 and included service in various sales, sales promotion and advertising activities of the company. In 1940, he was made manager of the Merchandising Division at

FULLMAN Latrobe PRODUCTS

FLOOR BOXES · WIRING SPECIALTIES

FULLMAN MANUFACTURING CO. QUALITY AT LATROBE SUPREMACY LATROBE, PA.

INSTALLED IN MINUTES— LAST FOR GENERATIONS!

In a matter of minutes, "Latrobe" Floor Boxes and Wiring Specialties can be installed or applied.

Carefully designed of highest grade materials, they render excellent service for generations.

No. 110 "Latrobe" Watertight Box

Simple and compact in design, the No. 110 Non-Adjustable, Watertight Floor Box is quick to install and gives trouble-free service. 208 Receptacle. Cover Plate 3½" diam.

No. 150 Box— No. 207 Nozzle

An adjustable, watertight box for installation in concrete or wood-finished concrete floors. Furnished with 4¼" Cover Plate #242 and large Adjusting Ring #215.

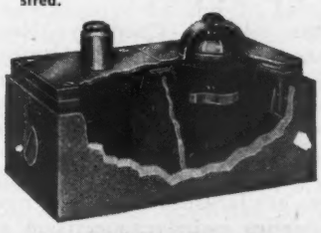
No. 280 Nozzle with No. 200 Cover Plate

10 Amp. 250 Volt Receptacle in Brass Housing, mounted on ½" brass pipe extension 3" long—longer extension available if desired.

No. 470 "Latrobe" Pipe or Conduit Hanger

Made of highest grade malleable iron and cadmium plated, the No. 470 is unexcelled for hanging ½", ¾" and 1" pipe or conduit to steel beams up to ⅜" thick. Larger hangers for larger pipe.

Sold Only Through Wholesalers



No. 252-R Two Gang Box With #206—207 Nozzle

Adjustable—with No. 208 Receptacle in one section. One Cover Plate has ½" Flush Brass Plug; other has 2" Flush Brass Plug.

No. 284 Nozzle with No. 200 Cover Plate

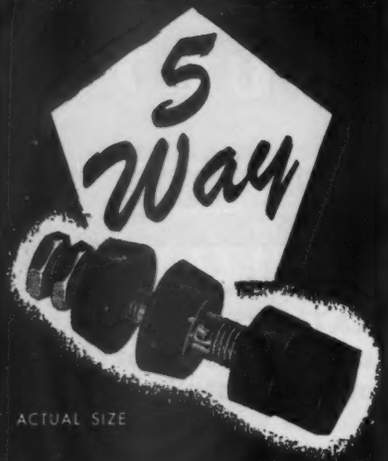
Neat, compact-fitting and extremely durable, this Duplex Receptacle Nozzle does fine job with either ½" or ¾" brass pipe extension.

FULLMAN MANUFACTURING CO.

LATROBE . . . PENNSYLVANIA

THE SUPERIOR

5 Way



ACTUAL SIZE

BINDING POST

AVAILABLE NOW WITH CAPTIVE HEAD

The Superior Electric Company has developed this binding post to give complete insulation, 30 ampere current capacity and 1000 volt working voltage. The captive ½" hexagonal head eliminates fumbling—makes a fast, complete, multi-purpose electrical connector.

Features Five Connections

1. Permanent clamping of wire up to #12 through center hole.
2. Looping of wire around center shaft and clamping.
3. Plug-in of standard ¼" banana plug.
4. Clip-lead connection by turning hex-shaped head to end of shaft.
5. Spade lug connection.

The 5-WAY Binding Post, available in tough red or black phenolic plastic, is offered for immediate delivery. Write for descriptive literature today.

THE SUPERIOR ELECTRIC COMPANY
610 Meadow Street
BRISTOL, CONN.

W. W. KEMPHERT

Harrison, later serving in other sales executive positions.

J. J. Topolinski, works manager of Skilsaw, has been elected vice president in charge of manufacturing. He joined the organization in 1932, having been successively production manager, superintendent and, since 1943, works manager.

Videon, Inc. Staffed By Lighting Engineers

A new lighting fixture company, known as Videon, Inc., has been formed.

The officers of this firm are David M. Goldring, president, Milton Liberman, vice president and Edwin R. Manning, secretary-treasurer. The offices are located at 20 East 33rd Street, New York.

Both Messrs. Goldring and Manning are former members of the staff of Holophane Company and were recently associated with Gruber Bros., Inc. Mr. Liberman has been with the Brooklyn Navy Yard as a designer and as plant superintendent of Gotham Lighting Corp. in New York.

Graybar Appointments

Graybar Electric Company, New York, has announced the appointment of L. G. Fields as district manager at Richmond. He succeeds J. H. Pearson, Jr., who is retiring after 22 years of service.

R. B. Sayre has been named district manager at Jacksonville. His new responsibilities include supervision of branches at Orlando, Miami and Tampa, Fla. Mr. Sayre succeeds Mr. Fields.

C. E. Kirkpatrick has been appointed branch manager at Memphis. He succeeds Mr. Sayre.

John Porter has been named manager of the Albany branch, succeeding Mr. Kirkpatrick.

H. M. Nazor has become manager of the Syracuse branch, succeeding J. E. Carroll, who has been appointed

DEPENDABLE "Old timer"

Paragon

ESTABLISHED 1905

300 Series

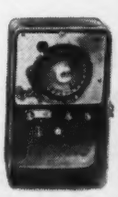
LIST FROM $14.00

TIME CONTROL SWITCHES

For better construction and easier maintenance of your installations, depend on timers ... Paragon Engineered ... Underwriters Approved ... Telechron Motored. The 300 Series shown above are popular for Stokers, Oil Burners, Pumps, Valves, Window and Sign Lighting.

ASK YOUR JOBBER

700 Series. 7 day Dial Time Switches. Setting for each day in week. For Heating ... Ventilating ... Air Conditioning. From $32.50 List.



PS-30 Series. Poultry Time Switches for permanent installations. Provision for Bright and Dim circuits. $13.50 List.

LIBERAL TRADE DISCOUNTS

PARAGON ELECTRIC COMPANY
1614 TWELFTH ST.
TWO RIVERS, WISCONSIN

SIMPLICITY PLUS!

New NON-INDUCTIVE CABLE RACK

for INDUSTRIAL PLANT WIRING

Type D-F 3-Conductor Cable Rack, New Non-Inductive Design. Racks available for cable sizes from 5/16 to 2⅝"

● Radically different, the new M. & W. Non-Inductive Cable Rack is designed for A.C. or D.C. systems. Racked Cables only partially surrounded by metal eliminates any chance of induced current in the rack. Impedance reduced with cables mounted in delta formation. Rack of one-piece construction ... installation of cables made quick and easy through the use of split bushing.

Send today for Bulletin C-S-51 which illustrates the complete line

THE M. & W. ELECTRIC MANUFACTURING CO., INC.

EAST PALESTINE, OHIO

ELECTRICIANS

Save time, hard work in tough masonry ...

Drill it fast, easy with hard, diamond-like Kennametal Masonry Drills

Get Results Like This:

"50 holes—1½ inches deep in tile, per grind. Speed—40 seconds per hole."

"Average 100 holes, 3½ inches deep in cement between re-grind. Speed—15 seconds per hole."

"Saved 7½ hours in one day with one bit. Go on new job tomorrow. Saved money—had easier going."

PLASTER, BRICK, TILE, LIMESTONE, CEMENT, are drilled up to 5 times as fast. The Kennadrill stays sharp up to 100 times longer. Blade action ejects the cuttings, prevents binding, sticking. Holes are clean, true, sharp edged. Bits are ¼" to 1½" in diameter. Can be used in hand braces, drill presses, light rotary drills. Write for bulletin EK now.

In Hardware Stores Everywhere

KENNAMETAL Inc. LATROBE, PA.

to the Executive Staff at Graybar headquarters in New York, reporting to E. F. Murphy. G. R. Muller has been named operating manager at Syracuse.

N. W. Zilch has been appointed Akron manager, succeeding Mr. Nazor.

F. F. Jaspersen has been appointed branch manager at Washington, D. C.

Bright Light Representatives

The Bright Light Reflector Company, Inc. of Bridgeport, Conn. has announced the appointment of L. W. Roberts Co. as representative in Virginia and North Carolina.

L. Morris Landers Co. of Atlanta Ga. has been named representative and will cover Georgia, Mississippi, Alabama, Florida, Tennessee and South Carolina.

•

Ward Leonard Electric Co., Mount Vernon, N. Y. has announced that its Rochester branch office, formerly located in the Lincoln Alliance Bank Bldg., has moved to 66 South Street, Rochester.

•

Allen-Bradley Company, Milwaukee has announced the removal of its Northern Ohio district office to 4312 Carnegie Avenue, Cleveland, Ohio.

•

Cutler-Hammer, Inc., Milwaukee, Wis. has opened new quarters at 1331 Dragon Street, Dallas, Texas. E. K. Anderson is Dallas district manager.

•

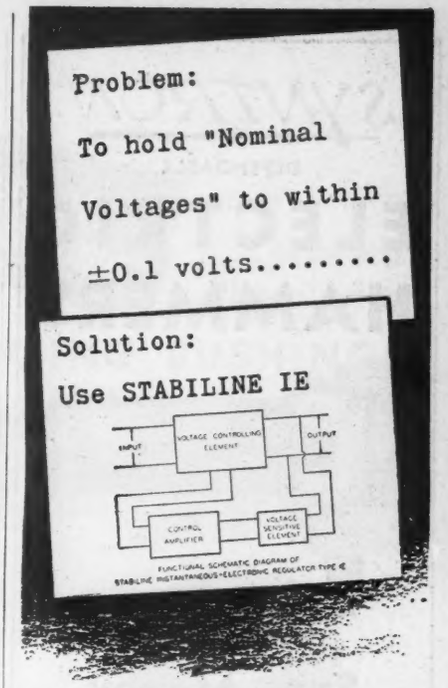
Carlton Cooley, 245 Edgar Road, St. Louis, Mo. has been appointed sales representative for the St. Louis territory by **Penn-Union Electric Corporation**, Erie, Pa.

•

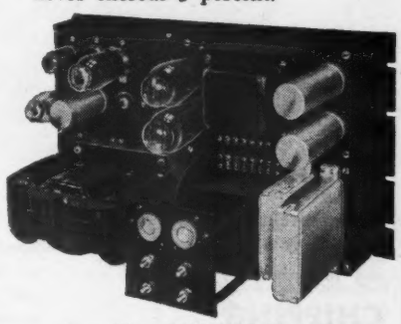
Edward P. Dykstra, formerly advertising manager of the D. A. Stuart Oil Co., has been appointed advertising manager of the **Unistrut Products Company**, Chicago.

•

Appleton Electric Company, Chicago, Ill., has named Bruce Bennett to its sales organization. He will make his headquarters at 5831 Dewey Avenue, Indianapolis, Ind. and will cover the state of Indiana, as well as the cities of Danville and Mattoon, Ill.



Your utility company may quote a nominal voltage—but power suppliers are allowed to vary, within certain limits, from the nominal. This condition, plus load changes in your own operation, results in voltages other than nominal. A STABILINE Automatic Voltage Regulator Type IE in your power line assures you of constant voltage. It's *instantaneous* in action — completely *electronic* in operation. Holds delivered voltages to within ±0.1 volts, regardless of line variation . . . within ±0.15 volts for any load current change or load power factor change from lagging .5 to leading .9. Maximum waveform distortion never exceeds 3 percent.



Rear View STABILINE Type IE

Bulletin 547 gives you information on this and other Superior Electric voltage control equipment. Write for your copy today.

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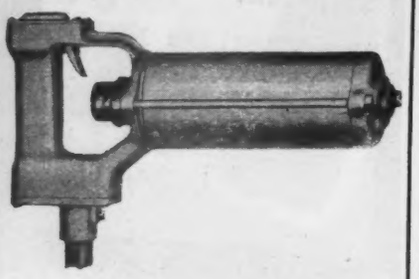
610 Meadow Street

BRISTOL, CONN.

SYNTRON

DEPENDABLE

ELECTRIC HAMMERS



Save Money and Time

DRILLING
in concrete and masonry to hang shafting, anchor machinery, install lighting fixtures, etc.

CUTTING
concrete and masonry for riser holes, doors and window openings, channeling for conduit, etc.

CHIPPING
old concrete, removing old mortar from between brick and stone for waterproofing.

BUSH HAMMERING
concrete surfaces.

VIBRATING
concrete forms.

SCALING
concrete, rust and old paint from equipment.

Write for illustrated folder

SYNTRON CO.
690 Lexington, Homer City, Pa.

Walker Brothers of Conshohocken, Pa. has opened a new office at 1025 Connecticut Avenue, N. W., Washington, D. C. J. J. Reilly has been named manager of this office.

•

Larkin Transformer Division of Larkin Lectro Products Corp., New York City, has acquired the engineering services of George Cooper, who for many years was associated with the Line Material Co. of Zanesville, Ohio.

•

Associated Research, Incorporated, Chicago, has appointed Clark H. Pasmore and Roland C. Koehler of Detroit as engineering representatives for the state of Michigan.

•

Benbow Manufacturing Company, Redwood City, Calif. has announced the appointment of A. A. Schueler as general sales manager. Mr. Schueler was formerly general sales manager of the Square D Western Division.

•

Stephen J. Daly, formerly special assistant to the director of advertising, E. I. duPont de Nemours & Company, Inc., Wilmington, Del., has been named advertising manager of **Owens-Corning Fiberglas Corporation**, Toledo, Ohio.

•

Minnesota Mining & Manufacturing Co., St. Paul, Minn. has announced the appointment of Harvey J. Livermore as staff manager of process development, working on the staff of the vice president in charge of production.

Robert W. Adam has been named production manager of the "Scotch" tape division.

•

Electro Manufacturing Corporation, Chicago, has announced the appointment of Snyder Associates to represent them in New York City and vicinity, New Jersey, Eastern Pennsylvania, Delaware and Maryland excluding Baltimore and vicinity.

•

Appointment of Walter E. McArthur as eastern regional manager for the **Nelson Stud Welding Division** of Morton-Gregory Corporation has been announced.

Robert H. Simon, for the past two years field engineer in the St. Louis area, becomes field engineer in the New York territory.

HOYT
AC LINE TESTER
. . . . for a quick line on voltages!

How many volts in the line? On the answer depends the efficient operation of every electrical machine or accessory. And here's how to get the answer—fast! The HOYT Model No. 568 AC Line Tester quickly and accurately indicates actual AC volts at any outlet! Test leads with special probes speed this vital check-up, while a carefully designed dial makes readings easy and precise. A red line on the 2-range scale (0/150/300 volts) indicates 110 and 220 volt readings. This precision HOYT Meter is ruggedly built to give you long, high quality service, yet it's compact enough to fit conveniently in your coat pocket! Ample insulation of the test leads makes it completely safe to use. Ideal for industrial testing and checking and for shop or bench work. Order this indispensable Tester from your Jobber today!

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292 MAIN STREET, CAMBRIDGE 42, MASS

for Dependable
INSTALLATIONS
and Dependable
REPEAT BUSINESS

NALCO
INFRA-RED
LAMPS

Nalco Infra-Red Lamps may be had in either inside silvered (self - reflecting) or clear glass type (for use with reflectors).

Designed especially for industrial use, time tested and job tried—NALCO Infra-red Lamps with their long lasting carbon filament and sealed, reinforced base give installations that are enduring and dependable. This in turn assures the dealer that he can depend on a steady stream of reorders from satisfied users. Stock NALCO Infra-Red Dritherm Lamps for more industrial business.

See your Electrical Wholesaler

NORTH AMERICAN
Electric Lamp Co.

1044 Tyler St. St. Louis 6, Mo.

...prevent them with

ADALET INSULATING BUSHINGS

NEW! PRECISION MOLDED! LOW PRICED!

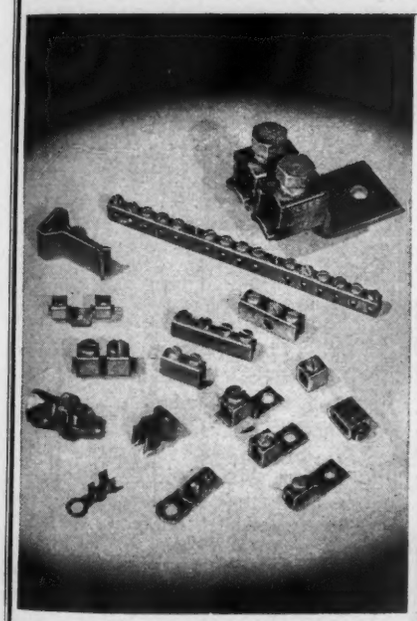
Designed and engineered by the Originators of the Famous SALI Insulating Bushings

A FORWARD STEP by ADALET

Order from your wholesaler, or write today for sample bushing and prices.

THE ADALET MANUFACTURING CO.
14300 LORAIN AVE.
CLEVELAND 11, OHIO

ILSCO
Electrical Connectors



MANY TYPES AND SIZES
WRITE for 54-page illustrated catalog.

ILSCO COPPER TUBE & PRODUCTS, Inc.
CINCINNATI, OHIO

THEY GIVE *More Light* FOR THE MONEY!

STONCO
Floodlights

WEATHER PROOF
CAST ALUMINUM

STONCO Floodlights use the SEALED BEAM type lamp, in which beam and light are combined in one unit for greater lighting efficiency and economy. Result: they give more light or less current than can ever be obtained from lamps using the wasteful open-type reflectors. STONCO Floodlights are preferred everywhere for Service Stations, Sports Arenas, Industrial and Advertising Applications.

No. B-1557—
Five STONCO Floodlights mounted on 2" pipe with concealed wiring adjustable to all angles.

Write for Catalog

Sold Exclusively Through Wholesalers — Prompt Delivery

No. B-142—
STONCO Floodlight can be used anywhere, can be mounted on a 3" or 4" outlet box. Adjustable to any angle.

STONE MANUFACTURING COMPANY
489 Henry Street, Elizabeth 4, N. J.

Give these eye-opening facts on power systems to the men you depend on for savings

Up-to-the-minute 'Pack of Facts' points way to many plant economies

Are all the men in your plant responsible for savings fully aware of the difference that modern *plant power distribution* can make? Do they know how it affects plant layout... productivity... costs? Get the latest facts to them *now!*

IT'S EASY—General Electric, as a service to industry, has prepared the facts for you in visual terms that are easy-to-take... linger in the memory.

Here's what the power distribution program offers:

1. **A fact-packed manual** providing up-to-the-minute data on plant power distribution. Objective, *without sales bias*, it helps solve your power problems.
2. **A slidefilm with sound** that tells what load-center distribution is, and what it does. It aids the men who run your plant make money-saving decisions.
3. **Fully illustrated highlights booklets,** for individual study and review.

Convince yourself first—

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GENERAL ELECTRIC

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[FROM PAGE 68]

incandescent reflector units, both over the main display area, and in adjustable recessed show window spots at the window line. Fluorescent lamps are installed above the louvered portions of the ceiling and all area above the louvers is painted flat white. Near the window wall, lamps are spaced close together, with the spacing increasing between lamps toward the rear wall. This provides a varying lighting intensity ranging from 120 footcandles near the window to 70 footcandles at the rear wall, simulating the daylight effect and accenting the sides of the cars near the window.

Suspended luminous indirect continuous row fluorescent units were used by Beikirch Bros. (Photo 7) in Rochester, N. Y., to simulate diffused skylight in their salesroom. Individual recessed incandescent reflectors are used both in the main sales area and at the window line to add additional sparkle and highlights, simulating the effect of direct sunlight.

Continuous rows of semi-recessed Holoflux units, installed normal to the all-glass front, were used to light the Greer-Robbins Company show room (Photo 4) in Beverly Hills, California. The cars are displayed in such manner that reflection of the continuous lines of light from overhead run parallel with the length of the cars, thus accenting the length of the cars. All interior finishes, including the floor, are of high reflection value, which provides a high diffusion of light on all parts of the cars. Over 40 footcandles of light are maintained in service, and the bright interior attracts attention to the displays from all pedestrian and motorized traffic.

Combination recessed fluorescent and incandescent direct lighting (Photo 2) was used in the Downtown Motors display room, Buffalo, N. Y., to provide more than 50 footcandles. Autos are displayed with the length of the cars parallel to the continuous lines of light to accent body length, and to prevent distortion of body shape from cross reflections of lines of light across the cars at angles. The warm tone of incandescent lamps in the adjustable spots aids in accenting features of autos on display, contrasting with the cool white light of 4500-degree fluorescent lamps. All interior surfaces, including the floors, are of high reflection value, which aids in

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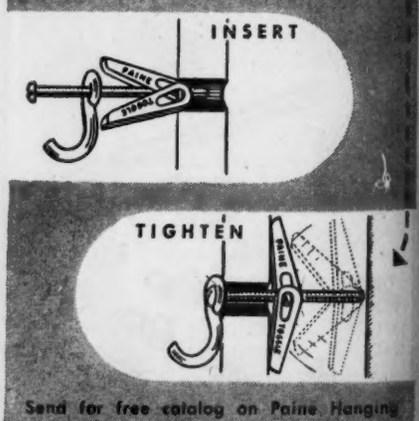

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